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FNCV DIARY

General Meetings

Held on the **second Monday** of the month (except for public holidays), 8.00 p.m. at the National Herbarium, corner of Birdwood Avenue and Dallas Brooks Drive, South Yarra. Meetings include a talk by a guest speaker. All members of the public are welcome.

Monday 12th February
"The new V.C.E. Geology course for years 11-12". Speaker Mr Darold Clindworth.

Monday 19th March
"Beetles". Speaker Mr Peter Kelly.

Monday 9th April
"The work of the marine research group of the National Museum". Speaker Mr Clarrie Handreck.

FNCV Excursions

Held on the **First Sunday** of each month and open to all FNCV members and visitors. For bookings or further details contact the excursion secretary Mrs. Joan Harry (850 1347).

Sunday 4th February
Excursion to the Belgrave and Sherbrooke area. Meet at the Belgrave station car park at 10.15 a.m. Train leaves station at 8.43 a.m. Leader Hillary Weatherhead.

Friday 9th (evening) – 12th March
Annual Victorian Field Naturalists Labour Day get-together at Ocean Grove. Hosted by the Geelong Field Naturalists Club. For further details see inside back cover of November/December *Victorian Naturalist* or phone the Excursion Secretary.

Sunday 1st April
General Excursion by bus to the Tallarook area. Bus departs Batman Avenue 9.30 a.m. Leader Mr Peter Kelly.

Group Activities

Fauna Survey Group

The group contact is Julian Grusovin (Phone 543 8627 A.H.).

Meetings

8 p.m. on the **first Tuesday** of the month, National Herbarium.

March 6th
Annual General Meeting.

Excursions

Sat. 10th – Sun. 11th February
Water rats at Werribee.

Saturday 17th February
Stag watch for Leadbeater's Possum, Powelltown 7.00 p.m.

Sat. 3rd – Sun. 4th March
Bettong survey, Barmah Forest.

Sat. 10th – Mon. 12th March
Nooramunga.

(cont. inside back cover)

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Cover photo: Trees and wood debris in steams provide important fish habitat (see Koehn and O'Connor p.5) Photo J. Koehn.

From the Editors

To mark the start of a new decade we have redesigned the front cover in a style similar to that used during Norman Wakefield's time as editor. We feel that this more traditional design reflects the long history of *The Victorian Naturalist* which is now in its 107th year, a fact of which the FNCV is proud.

During 1989 we have endeavoured to broaden the content of the *Vic. Nat.* so that readers have a blend of informative articles on topical issues, research reports of scientific significance and naturalist news. We have established an editorial policy and new guidelines for contributors (see page 38) to encourage contributions from a wide range of readers. Letters also are always welcome.

This issue contains three articles on native freshwater fish and together they encapsulate the *Vic. Nat.* approach to presenting natural history. The article by Koehn and O'Connor (p.5) provides an overview of the adverse effects of inappropriate stream management on fish. Koehn and Morison (p.13) review the current conservation status of our native freshwater fish and Lintermans and Rutzou (p.26) describe a new locality for the uncommon Two-spined Blackfish.

With the current interest in revegetation, Ian Clarke's article (p.28) on an early species list for the Merri Creek, Melbourne is timely. This list was orginally compiled by the eminent naturalist, the Reverend H. M. R. Rupp in 1896.

We hope you enjoy this issue of the *Vic. Nat.*

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Threats to Victorian native freshwater fish

J. D. Koehn[1] and W. G. O'Connor[2]

During the process of assessing the conservation status of native freshwater fish species in Victoria (Koehn and Morison 1990) it became apparent that there were serious declines in the range and abundance of many species. While such declines are well documented for some species (e.g. Macquarie Perch *Macquaria australasica*; Cadwallader 1981), the status of others remains relatively unknown (e.g. Yarra Pigmy Perch, *Edelia obscura*).

The exact reasons for such declines may vary between species, from location to location, be unknown or be a combination of factors, but there has been one common, overwhelming cause: habitat alteration. Changes to habitat have accelerated since the arrival of Europeans to Australia and have often continued almost unnoticed. Dr Peter Maitland whilst addressing the Australian Threatened Fishes Conference as a visiting representative of the International Union for the Conservation of Nature, put it succinctly: 'The major single cause throughout the world of the extinction of populations of fish (and indeed most other species of both plants and animals) is the destruction of habitat' (Maitland 1987).

A fish's habitat consists of both its surrounding medium, the water and associated physical structures. These physical structures include streambanks, substrate, instream debris (logs, branches, etc), aquatic and streambank vegetation, all of which may be used for shelter, food supply, spawning and rearing areas and territories. These provide the diversity of habitat necessary to provide the needs for the range of fish species present. Often fish numbers can be correlated to the suitability of the habitat. From a managerial and aesthetic viewpoint, this diversity often constitutes what appears to be an untidy, cluttered and inefficient arrangement of instream structures.

A stream is completely dependent on the surrounding land and vegetation in its catchment and is consequently subjected to the effects of actions carried out there. The areas surrounding a stream and its tributaries are especially important in determining the quality of the stream. A stream is also a system of habitats linked together by a continuous one-way flow of water, so the actions on a stream at one point can also affect areas downstream.

The majority of native freshwater fishes occur in rivers and streams which form most of the freshwater aquatic habitats in Victoria. Few species are completely dependent on lentic (non-flowing) habitats such as lakes, swamps, billabongs and wetlands. Although this paper primarily concerns itself with lotic (flowing) ecosystems it is recognised that lentic habitats face a wide variety of threats and that habitat changes such as drainage can be rapid and dramatic.

Unlike terrestrial ecosystems, fish and their environments are hidden below the water surface and hence the degradation of their habitats and other threats they face often pass unnoticed. In a recent poll, the majority of public considered a lack of stocking, pollution and Carp to be the most important issues facing freshwater fisheries (Fisheries Division 1987). Such responses fail to consider the most serious threats to freshwater environments. Ecological factors are not generally widely recognised by the public as major concerns to freshwater fisheries.

In an attempt to redress this imbalance, this paper presents a review of the major threats to native freshwater fish in Victoria.

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Bankside Vegetation Removal

Naturally occurring native vegetation surrounding a stream is essential for the well-being of the aquatic ecosystem, and there is a continuous interaction between this zone and the stream. Most of the instream habitat available for fish e.g. fallen trees, logs, wood debris, leaves, bark, tree roots, etc. originates from the surrounding bankside vegetation. In many streams, such organic matter forms the major primary source of nutrients for the aquatic food chain. The supply of this material from streamside vegetation replaces energy used in biological processes and lost by downstream displacement. Introduced deciduous species such as willows or poplars alter the timing, quality and consistency of this energy supply. Additional fish food in the form of terrestrial invertebrates also originates from this vegetation.

By helping consolidate stream banks, the root systems of bank vegetation prevent erosion and hence sedimentation (P. Jackson pers. comm.). Submerged roots also provide instream habitat. Streamside vegetation acts as a buffer strip helping to filter sediment, pasture effluent and chemicals in water run-off from surrounding areas and is important in protecting bank areas from disturbances such as stock damage (Anon 1983). Shading helps to reduce summer stream temperatures and provides habitat areas for species avoiding sunlight.

The clearing of bank vegetation has been widespread in Victoria, and is particularly prevalent in lowland streams flowing through agricultural areas. The impact of this action, especially clearing right up to the waters edge, on stream ecosystems has not been fully realised. The loss of a nutrient source (organic matter) alone may have reduced the overall productivity of streams. Certainly the loss of inputs of instream habitat can lead to a reduction in fish numbers, especially of those species dependent on logs and wood debris for habitat or spawning sites.

Fig. 1. Removal of streamside vegetation remains a major environmental problem.

Habitat Removal

The removal of instream habitat by desnagging and clearing of streams remains a widespread practice in Victoria. Fish use snags and other habitat to shelter from water velocity, predators, competitors and sunlight; as territorial 'markers', for spawning sites and for food supply sources. Species such as Murray Cod (*Maccullochella peeli*) and Freshwater Blackfish (*Gadopsis marmoratus*) are known to lay adhesive eggs on or in logs and the removal of such spawning sites is likely to lead to reduced breeding success. Both of these species have suffered serious declines in range and abundance (Jackson and Llewelyn 1980; Cadwallader and Gooley 1981) and the removal of snags is probably a contributing factor (Cadwallader 1978).

Channelization can remove almost all instream habitat. The Western Port catchment provides many examples of this extreme form of habitat alteration and fish populations have been shown to be adversely affected (Hortle and Lake 1983; Koehn 1986a). The concrete channels in Dandenong Creek have been shown to contain few (or no) fish (Koehn 1986b). Similarly, the widespread drainage of swamp and wetland areas has reduced the preferred habitat areas for species such as the Southern Pigmy Perch (*Nannoperca australis*) and Dwarf Galaxias (*Galaxiella pusilla*). Control of flooding can also lead to reductions in off-stream habitats such as swamps and billabongs.

Fig. 2. Channelization removes almost all habitat attributes.

Sedimentation

Point sources of sediment such as dam and road constructions, mining operations, unmade roads and cattle access points are all readily recognised. More widespread, but less recognisable inputs arise from agricultural and forest areas where over clearing and poor land management practices have occurred.

The removal of bankside vegetation contributes to sedimentation by increasing bank erosion and allowing runoff from surrounding areas to enter the stream unfiltered.

While the damage to a hillside gully or streambank is visual evidence of the problems of erosion, the damage to the aquatic environment usually remains hidden under the resultant turbid water. The major effect of sedimentation is the blanketting of the substrate and the filling of pools and scour holes. This decreases substrate variation and hence usable habitat areas. A diversity of habitat is necessary for the requirements of different species and their different life stages. Clogging of the substratum removes spaces between particles which are used as rearing and habitat areas by juvenile fish, small species and stream invertebrates. The eggs of species such as Macquarie Perch (*Macquaria australasica*) which are deposited in gravel substrate are liable to smothering by sediment. Species such as Freshwater Blackfish which lay adhesive eggs, require relatively clean sites for attachment. If such sites are covered with sediment, spawning may not be possible. The eggs and larvae which remain attached to the spawning site for several weeks may also be smothered by sediment (Blyth and Jackson 1985).

Reduced Water Quality

Although water quality problems are usually associated with the input of toxic pollutants, they can also include the deterioration of a wide variety of water quality parameters.

Fish kills from toxic discharges are readily recognised and occur frequently in urban waters. Similar kills in rural areas can often be attributed to the use of pesticides. Toxic pollutants which do not kill fish immediately, may have sub-lethal effects leading to reduced feeding or spawning ability, poisoning through bioaccumulation in the food chain, or the loss of the invertebrate food supply. Some toxins such as heavy metals accumulate in the tissues leading to a gradual deterioration of the health of a fish. Unlike birds or terrestrial animals, fish have no means of escape from the contamination of their environment. Lesser changes in levels of other chemicals may have more subtle effects on fish populations by providing a less suitable environment.

Water provides dissolved oxygen for respiration, temperature for metabolism and flow of nutrients through the ecosystem. Dams and reservoirs in particular have the capacity to seriously alter all of these parameters. It is common for the bottom layers of reservoirs to form cold layers completely lacking in oxygen. This not only produces habitat areas within the impoundments which are unsuitable for fish, but can also result in the release of de-oxygenated water into the stream.

Impoundments are also a major cause of changes to the water temperature in streams. Most impoundments in Victoria utilize only bottom outlets which release cold water from the lower levels of the water column. A reduction in stream temperature may severely limit the growth rates of fish. Often releases are made for irrigation purposes during summer when stream temperatures are normally high. This is when many species such as Murray Cod breed, and if optimal temperatures are not reached, then sexual development and successful spawning may not occur. The feeding activity and metabolic rate of fish also depend on water temperature.

Each species has a specific temperature tolerance level and fish kills may occur due to high temperatures, particularly when associated with reductions in dissolved oxygen levels. Water temperatures can increase markedly in summer months, particularly where there is a lack of shading from streamside vegetation.

Impoundments may also act as nutrient traps by allowing organic particles which normally flow down the stream to settle out. The water released downstream is therefore not as rich in nutrients as the inflow and so the productivity of the stream may be reduced.

High turbidities and salinities may also have adverse physiological or behavioural effects on fish. Stratification of pools due to temperature or salinity gradients may result in deoxygenated, saline bottom layers (Anderson and Morison 1990). These conditions may be exacerbated by reduced flows. Increased nutrient inputs from effluents or fertilizers may be directly toxic or have indirect adverse effects reducing oxygen levels or enhancing algal blooms. Algae may be toxic or dramatically reduce oxygen levels (Larkin and Northcote 1969).

A deterioration of water quality over the long term may be as serious as a direct toxic kill. Reduced environmental suitability increases stress, leaving fish more susceptible to disease, predation and lowered reproductive success.

Flow alterations

Water storages have the capacity to dramatically alter the flow regime. Discharges from storages used for irrigation purposes generally reverse natural flows, resulting in high flows during summer and low flows during winter. Natural fluctuations in water levels and seasonal flooding are reduced.

Stages of the lifecycles of many fish species are reliant on natural flow events

and alterations to, or the removal of such events may have serious consequences. Flooding is particularly important for the migration and spawning of many species. For example, the adults of Australian Bass (*Macquaria novemaculeata*) require seasonal high flows to migrate downstream to estuarine spawning grounds (Harris, 1986). A rise in water level during spring is thought to be a 'trigger' for spawning in such species as Silver Perch (*Bidyanus bidyanus*) (Lake 1967). If such conditions do not occur, or occur to a lesser extent due to flow regulation, then spawning may not take place.

Reduced flooding also means that highly productive floodplain areas which produce plankton blooms are not utilized. The production of such an abundant food supply is necessary for the rearing of fry and the flood-plain habitat provides nursery areas for the juveniles of many species (Geddes and Puckeridge 1988). Reduced flooding also reduces the chance to flush sediment and areas of poor water quality which may occur over long periods of low flow.

Sudden reductions in water levels, particularly such as those associated with the end of irrigation releases or the operation of hydro-electric schemes may leave fish and/or their eggs stranded above the water level. Certain species such as the Freshwater Blackfish whose eggs and larvae need to remain attached to the spawning site for several weeks may be particularly susceptible to a sudden drop in water level.

Water storages often result in a dramatic reduction in downstream flow. This can severely reduce the amount of habitat available to fish. Flow immediately below the Upper Yarra Dam for example, has been completely stopped, leaving the streambed almost dry for several kilometers before being fed at reduced flows by downstream tributaries. Streamflow studies have been conducted by the Fisheries Division (Department of Conservation, Forests and Lands) on waters such as the Thomson River to determine suitable flows to maintain adequate amounts of fish habitat (B. Tunbridge pers. comm.).

Reductions in streamflow also occur due to the damming of small tributaries and water extraction for irrigation purposes. The effects of water extraction can be severe as this practice is most prevalent during low summer flows.

Barriers

To be of use to fish, habitat areas must be accessible. As the majority of freshwater species in coastal drainages move to sea at some stage of their life cycle they need to be able to recolonize these freshwater habitat areas. Barriers prevent this, and indeed some species have been found absent from drainages where barriers occur (Koehn 1986a). Water storages also form major barriers to fish passage in Victorian streams. Fish passage may also be obstructed by flood barriers, drop structures, causeways and road crossings.

Many species also need to migrate to spawn. Golden Perch (*Macquaria ambigua*) may make extensive upstream migrations prior to spawning, whilst the Common Galaxias (*Galaxias maculatus*) migrates downstream to spawn in the estuary. If migrations to spawning areas are obstructed, then spawning may not be possible. Several coastal species such as the Broad-finned Galaxias (*Galaxias brevi-*

Fig. 3. Water storages cause barriers to fish passage and other environmental problems.

pinnis) spawn in freshwater, but their eggs or larvae are swept to sea. If the larvae are swept into a water storage their survival is uncertain.

At present few barriers incorporate any type of 'fish ladder' and so fish passage remains a major environmental problem for many species in Victoria.

Introduced Species

The most widely distributed introduced species is Brown Trout (*Salmo trutta*) (Cadwallader and Backhouse 1983). Together with Rainbow Trout (*Oncorhynchus mykiss*), these species are widely stocked (Barnham 1989) and as voracious predators pose a major threat to smaller native fish. The effects of Brown Trout on the distribution and abundance of Mountain Galaxias (*Galaxias olidus*) have been comprehensively documented with mutually exclusive populations often occurring (Tilzey 1976; Cadwallader 1979; Fletcher 1979; Jackson and Davies 1983). Overlap in the diet of Brown Trout and Freshwater Blackfish and the deleterious effects on the distribution of other native species has been found by Jackson (1978) and Jackson and Williams (1980). Despite the overlap in diet, blackfish coexist in streams with Brown Trout, probably because the two species occupy different habitat areas (Jackson 1978). Trout have been noted as a particular threat to the endangered Brown Galaxias (*G. olidus* var. 'fuscus'), (Koehn and Morison 1990) and may also prey on Australian Grayling (*Prototroctes maraena*). Mosquitofish (*Gambusia affinis*) are known to eat fish eggs, juveniles, and aggressively attack fish by nipping their fins. It is thought to have been responsible for the extinction of several fish species in Africa and Southeast Asia (Cadwallader and Backhouse 1983), but its effect in Australia has not been documented. Mosquitofish may be detrimental to species which inhabit similar habitats such as the Dwarf Galaxias and Southern and Yarra Pigmy Perches.

Competition for both food and habitat space also occurs between other native and introduced species. The diets of Murray Cod and Golden Perch for example overlap with Redfin (*Perca fluviatilis*) Carp (*Cyprinis carpio*) Roach (*Rutilus rutilus*) and Goldfish (*Carassius auratus*).

The effects of Carp numbers on native fish is unclear. Dietary overlap between Carp and native species does occur (Hume *et al.* 1983), and in large numbers Carp must produce considerable pressure for habitat space. The destruction of weedbeds in lakes may also remove native fish habitat. Redfin may pose a special threat to native fish species through the spread of Redfin virus (Langdon *et al* 1986). Preliminary tests have shown that Mountain Galaxias and Macquarie Perch are both susceptible to this virus (Langdon 1988).

Several exotic species used in the aquarium trade are known to have established populations in Victoria (Cadwallader and Backhouse 1983; Allen 1984).

Fishing

The removal of fish from a stream can obviously only decrease the abundance of that species. Overfishing of native fish stocks by commercial fishermen and poachers in the Murray-Darling river systems has probably contributed to their decline in many areas. Angling during the spawning migration has been suggested as having a deleterious effect on Macquarie Perch stocks in Lake Eildon (Cadwallader 1978) and for this reason, the population of this species in Lake Dartmouth is subjected to a closed season during spawning. Angling is often suggested as a reason for the decline of other species, but this remains unsubstantiated.

As only 9 of the 42 native freshwater fish species may be considered of angling importance (Barnham 1983), fishing cannot explain the serious declines suffered by populations of other species. Compared to the deleterious effect of habitat

modifications previously discussed in this paper, with the exception of occasional specific instances, angling should not be considered a threat to most native freshwater fish species.

Conclusion

General deterioration of a fish's environmental conditions does not usually cause death, but is likely to have other effects which lead to a general decline in population. A less than optimal habitat may lead to reduced longevity, growth rates and spawning success. Over several years this accumulative decline may lead to the demise of a fish population.

The threats discussed have been considered in isolation, but often more than one threatening process is in operation and interactions between such processes may increase their effects. Similarly, the effect of one threatening process may affect many areas of the ecosystem and several fish species e.g. sedimentation may remove spawning sites and reduce food supply.

Although an overall ecological approach is required for the effective management of these problems, steps can be taken to alleviate most of the aforementioned threats:

1. Replacement and maintenance of indigenous, native streamside vegetation zones at least 20 m in width (Clinnick 1984).
2. Minimization of habitat removal.
3. Adequate controls of sediment inputs from point sources and a general improvement in catchment land use.
4. Adequate controls over toxic spills, effluent discharges, chemical spraying and the provision of multi-level outlets from water storages.
5. Use of streamflow studies to determine and implement environmentally sensitive flow regimes; regulation of water extraction.
6. Provision of fish ladders and removal or modification of structures to provide fish passage.
7. Careful stocking and restrictions on the spread of introduced species.
8. Regulation of commercial and recreational fishing in sensitive areas.

Some of these actions are already in operation, but concerted efforts are needed to implement widespread management decisions in these areas before these threats to our native freshwater fish are reduced.

Acknowledgements

The authors wish to thank all those compatriots whose conversations have led to a better understanding of the environmental threats to freshwater fishes. Thanks to Tim Doeg for comments on the manuscript and to David Anderson for word-processing.

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A review of the conservation status of native freshwater fish in Victoria

J. D. Koehn[1] and A. K. Morison[2]

Introduction

The conservation status of native freshwater fish in Victoria was first documented in November 1982 (Cadwallader *et al.* 1984). This was seen as part of an Australia-wide review of the conservation status of native freshwater fish. In August 1985, the Australian Society for Fish Biology held a conference on Australian Threatened Fishes to define the criteria used for classification of the conservation status of Australian fish species and to publish a preliminary classification of species at risk nationwide (Harris 1987). Recommendations formulated at this conference were ratified by the Society and a Threatened Fishes Committee formed. This committee now meets annually to review the national listing.

Cadwallader *et al.* (1984) recommended that the Victorian conservation listing should be revised every five years. This document contains the first official revision.

Since the original review in 1982, there has been an increase in knowledge of freshwater native fish in Victoria. New species have been described formally, additional species have been located in Victoria, many fish surveys have been conducted and the relationships between some species and their environment have been investigated. The conservation status of several species has come under revision in recent publications (Brumley *et al.* 1987; Jackson and Koehn 1988).

The importance of a listing of the Conservation Status of species in Victoria has been highlighted by the determination of conservation priorities and management plans within government departments and the initiation of the Flora and Fauna Guarantee legislation by the Victorian State Government. This legislation allows for the listing of flora, fauna and habitat areas for protection throughout the State.

The purpose of the Flora and Fauna Guarantee and proceedures for its implementation have been outlined by Watson and Offor (1989).

The conservation categories adopted by Cadwallader *et al.* were based on Ahern's (1982) modifications of definitions from the Red Data Book (Holloway 1979) of the International Union for the Conservation of Nature (I.U.C.N.). The definitions and classification scheme used for the national conservation listing (Harris 1987) differed somewhat from those used by Cadwallader *et al.* (1984). Such changes have necessitated a review of the conservation status listing of Victorian native freshwater fish. The conservation status of each species was considered for Victoria only, with historical data on distribution and abundance elsewhere only relevant to their vulnerability in this State.

The Review

A meeting was held at the Arthur Rylah Institute for Environmental Research on 12 August 1989 to review the listings. Participants included Fisheries biologists, fish taxonomists, native fish naturalists and personnel with knowledge of the Flora and Fauna Guarantee legislation.

The purpose of the meeting was to:

a) decide whether or not to adopt the conservation categories used for the national listing (Harris 1987), or those used by Cadwallader *et al.* (1984).
b) decide the conservation status of each

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species considered by Cadwallader *et al.* (1984), after presentation and consideration of all available, relevant information.

c) decide the conservation status of additional species not previously listed.

d) provide a summary of the revised classification of conservation status of Victorian native freshwater fish to the meeting of the Australian Society of Fish Biology Threatened Fishes Committee meeting on 25 August 1989.

Results

The participants agreed that the categories used for the national conservation listing (Harris 1987) should also be adopted for this review of the Victorian listing. Two slight alterations were made to this classification scheme: the 'extinct' category definition was qualified by the addition of 'presumed in Victoria', and for completion, a further category of 'presently common and/or widespread in Victoria' was added. This is similar to the category 'common and secure' used by Cadwallader *et al.* (1984). This additional category provided a complete listing of all native freshwater fish taxa considered and ensures revision of their status in following reviews.

Conservation Status Category Definitions

PRESUMED EXTINCT IN VICTORIA

Taxa which are no longer found in the wild or in a domesticated state in Victoria.

ENDANGERED

Taxa which have suffered a population decline over all or most of their range, whether the causes of this decline are known or not, and which are in danger of extinction in the near future. (Special management measures required if the taxa are to continue to survive.)

VULNERABLE

Taxa not presently endangered but which are at risk by having small populations and/or by occupying restricted habitats susceptible to rapid environmental change and/or populations which are declining at a rate that would render them endangered in the near future. (Special management measures required to prevent the taxa becoming endangered or extinct.)

POTENTIALLY THREATENED

Taxa which could become vulnerable or endangered in the near future because they have a relatively large population in a restricted area; or they have small populations in a few areas; or they have been heavily depleted and are continuing to decline; or they are dependent on specific habitat for survival. (Require monitoring.)

INDETERMINATE

Taxa which are likely to fall into the Endangered, Vulnerable or Potentially Threatened categories but for which insufficient data are available to make an assessment. (Require investigation.)

RESTRICTED

Taxa which are not presently in danger but which occur in restricted areas, or which have suffered a long-term reduction in distribution and/or abundance and are now uncommon.

UNCERTAIN STATUS

Taxa whose taxonomy, distribution and abundance are not known but which are suspected of being restricted.

PRESENTLY COMMON AND/OR WIDESPREAD

Taxa presently common, abundant or widespread which face no immediate threat to their survival.

'Endangered', 'Vulnerable' and 'Potentially Threatened' are categories that are considered to contain Victoria's threatened fish. Harris (1987) recommended that action be taken to initiate conservation programs for species which fall into these categories on a national basis. Similar action is recommended for Victorian species in these listings. Further taxa may be placed in these categories after investigation of those whose status is presently listed as 'Indeterminate'.

Using the revised classification each species was assigned to a particular conservation category after the presentation and discussion of its distribution, abundance and environmental requirements (including habitat, breeding, feeding, movement and water quality needs). Particular attention was given to observed changes to distribution and abundance, and to potential threats to that species. The status of each species, on the basis of the categories, is given in Table 1.

The Fisheries Division has a breeding and re-stocking program underway for

Table 1: Conservation status of native freshwater fish species in Victoria. (Nomenclature follows Cadwallader and Backhouse 1983).

SPECIFIC NAME	COMMON NAME
Presumed Extinct in Victoria	
Mogurnda adspersa	Southern Purple-spotted Gudgeon
Ambassis agassizi	Agassizis Perch*
Endangered	
Nannoperca variegata	Ewens Pigmy Perch
Galaxias olidus var. 'fuscus'	Brown Galaxias
Maccullochella macquariensis	Trout Cod
Potamalosa richmondia	Freshwater Herring
Vulnerable	
Macquaria australasica	Macquarie Perch
Galaxias cleaveri	Tasmanian Mudfish
Prototroctes maraena	Australian Grayling
Bidyanus bidyanus	Silver Perch
Maccullochella peeli	Murray Cod
Tandanus tandanus	Freshwater Catfish
Potentially Threatened	
Edelia obscura	Yarra Pigmy Perch
Geotria australis	Pouched Lamprey
Macquaria novemaculeata	Australian Bass
Galaxiella pusilla	Dwarf Galaxias
Galaxias brevipinnis	Broad-finned Galaxias
Galaxias truttaceus	Spotted Galaxias
Macquaria ambigua	Golden Perch
Indeterminate	
Gadopsis marmoratus	Freshwater Blackfish
Galaxias rostratus	Flat-headed Galaxias
Galaxias olidus	Mountain Galaxias
Gobiomorphus coxii	Cox's Gudgeon
Indeterminate *(cont.)*	
Gobiomorphus australis	Striped Gudgeon
Craterocephalus stercusmuscarum	Freshwater Hardyhead
Craterocephalus eyresii	Lake Eyre Hardyhead
Restricted	
Gadopsis bispinosus	Two-spined Blackfish
Nematalosa erebi	Bony Bream
Melanotaenia fluviatilis	Crimson-spotted Rainbowfish
Uncertain Status	
Hypseleotris klunzingeri	Western Carp Gudgeon
Hypseleotris spp.	Midgley's / Lake's Carp Gudgeons**
Philypnodon sp.	Dwarf Flat-headed Gudgeon
Mordacia praecox	Non-parasitic Lamprey
Presently Common and/or Widespread	
Anguilla reinhardtii	Long-finned Eel
Anguilla australis	Short-finned Eel
Galaxias maculatus	Common Galaxias
Pseudogobius olorum	Blue-spot Goby
Arenigobius bifrenatus	Bridled Goby
Favonigobius tamarensis	Tamar River Goby
Philypnodon grandiceps	Flat-headed Gudgeon
Mordacia mordax	Short-headed Lamprey
Macquaria colonorum	Estuary Perch
Nannoperca australis	Southern Pigmy Perch
Retropinna semoni	Australian Smelt
Pseudaphritis urvillii	Tupong
Atherinosoma microstoma	Small-mouthed Hardyhead

*Zoological Catalogue of Australia Volume 7, p. 484.
**Hoese *et al.* 1980.

several warmwater native fish species. The program concentrates on three species of conservation concern: Trout Cod, Murray Cod and Macquarie Perch. The primary purpose of the program for these species is to improve their conservation status to and establish viable, self-sustaining populations. Golden Perch are released into many waters specifically to improve recreational angling but the establishment of breeding populations is not an essential part of the program. Although this program has been underway for several years, the success of stockings is still being evaluated and the establishment of self-sustaining populations has not been verified. For this reason, the reviewers decided that the re-stocking program should not be taken into consideration in assessing the conservation status of these species.

Of the 46 taxa of Victorian native freshwater fish considered, two are now presumed extinct in this State and another 17 are considered to be under threat.

Four taxa have been placed in the 'Endangered' category, which previously contained Trout Cod only (Cadwallader *et al.* 1984). Distribution areas and locality records for the two species 'presumed extinct in Victoria' and the four 'Endangered' species are given in Fig. 1, and these species are illustrated in Fig's 2-7.

Fig. 1. Locality records for fish species 'presumed extinct' or 'endangered' in Victoria: **(1)** Agassizis Perch: **(2)** Southern Purple-spotted Gudgeon: **(3)** Ewens Pigmy Perch: **(4)** Freshwater Herring: **(5)** Trout Cod: **(6)** Brown Galaxias.

A brief summary of the most important considerations for the listing of each species is given below:

PRESUMED EXTINCT

Southern Purple-spotted Gudgeon (Fig. 2) *Mogurnda adspersa*

Presence in Victoria confirmed by one museum specimen from Dinner Creek, Stawell, 1934 but the accuracy of this locality description is now in some doubt. There are no other confirmed records from this state. Specimens collected from Albury-Wodonga area (Cadwallader and Backhouse 1983) have recently been re-identified as *Philypnodon grandiceps* (R. Frankenberg pers. comm.). Previously listed as 'Restricted distribution, or rare...'

Fig. 2. Southern Purple-spotted Gudgeon *Mogurnda adspersa.*(Fisheries Division photograph).

Agassizis Perch (Fig. 3) *Ambassis agassizi*

Previously named the Western Chanda Perch (Zoological Catalogue of Australia Vol. 7 p.484). The species' presence in Victoria is confirmed by three museum specimens from the Mildura region, 1929. There are no other confirmed records from this State. Previously listed as 'Restricted distribution, or rare...'

ENDANGERED

Ewens Pigmy Perch (Fig. 4) *Nannoperca variegata*

A newly described species (Kuiter and Allen 1986) only found in one stream in far south-western Victoria. It is likely to

have suffered substantial population declines due to drainage of swampy habitat areas, creek clearing and channelization (as have other Pigmy Perch species). Such practices are common in this area and pose a continuing threat. Also found in Ewens ponds, South Australia.

Fig. 3. Agassizis Perch *Ambassis agassizi* (Fisheries Division photograph).

Fig. 4. Ewens Pigmy Perch *Nannoperca variegata* (Photo: Rudi Kuiter).

Brown Galaxias (Fig. 5) *Galaxias olidus* var. 'fuscus'

'Fuscus' is presently described as a junior synonym, and is a phenotypically distinct form of *G. olidus* (McDowell and Frankenberg 1981). Rich (1986) demonstrated genetic, morphological and ecological distinctness from *G. olidus* and suggested that 'fuscus' may qualify as a sub-species. Reproductive isolation was suggested in a sympatric population of these two forms but was not proven. 'fuscus' is now known to occur at only two localities in the upper Goulburn River system. At one site an apparently stable population exists in the absence of trout species; at the other, a population cohabiting with trout appears to be declining. 'fuscus' has disappeared from several other localities apparently after the introduction of trout. The detrimental effects of trout on populations of *G. olidus* have been well documented (Tilzey 1976; Fletcher 1979) and trout remain a major threat to the future of this taxa. Although trout stockings do not occur at the localities listed, stockings do occur in the catchments containing 'fuscus', (Barnham 1989) and threats come from self-maintaining and expanding trout populations. Previously listed as 'Restricted distribution or rare...'.

Fig. 5. Brown Galaxias *Galaxias olidus* var. 'fuscus' (Fisheries Division photograph).

Trout Cod (Fig. 6) *Maccullochella macquariensis*

Previously listed as Endangered, the status of this species remains unchanged. Cadwallader and Gooley (1984) listed 15 locations from which Trout Cod have been reliably reported since 1970. Since 1984, Trout Cod have been recorded from only two of these sites: the Murray River downstream of Lake Mulwala and Seven Creeks. Seven Creeks contains the only recently confirmed, viable population of this species in Victoria. Most of this population is located within a section of stream closed to angling and its distribution there appears relatively stable (Morison and Anderson 1987). Catchment man-

agement measures have been implemented to help prevent siltation and further degradation of instream habitat.

Fig. 6. Trout Cod *Maccullochella macquariensis* (Fisheries Division photograph).

Freshwater Herring (Fig. 7) *Potamalosa richmondia*

There are confirmed records from only two localities in Victoria: Museum of Victoria specimens collected from Hopkins River, Warrnambool, 1894 and specimens collected in 1976 from Little River, Mallacoota (McCarraher 1986). These sparse records may indicate a reduction in the species' range within Victoria and its continued existence in this state may be in doubt if such a decline continues. Previously listed as 'Restricted distribution or rare...'.

Fig. 7. Freshwater Herring *Potamalosa richmondia* (Fisheries Division photograph).

VULNERABLE

Macquarie Perch *Macquaria australasica*

The status of this species remains unchanged. There are few viable populations of Macquarie Perch in Victoria although there are infrequent reports of individual fish being caught from several localities. The decline in range and abundance of Macquarie Perch within this state has been well documented and attributed largely to habitat modification, particularly siltation of streams (Cadwallader 1981). A newly recognised threat is the viral disease epizootic haematopoietic necrosis (EHN). The EHN virus has been responsible for killing large numbers of Redfin (*Perca fluviatilis*) in south-eastern Australia, mainly in early summer outbreaks among O+ juveniles (Langdon and Humphrey 1987) and there is preliminary experimental evidence that Macquarie Perch (and other native species) are also highly susceptible to the virus (Langdon 1988). The virus may have been at least partly responsible for the decline of Macquarie perch populations in the past, such as the rapid decline observed in the once abundant population in Lake Eildon. There is concern that the only remaining large population of Macquarie Perch, found in Lake Dartmouth, may suffer a similar fate. Any serious decline in this population, or an increased risk from Redfin virus may necessitate a prompt review of the status of Macquarie Perch.

Tasmanian Mudfish *Galaxias cleaveri*

Because the adults of this species generally inhabit swamp areas, sampling is particularly difficult. One population has been located at Wilsons Promontory (Jackson and Davies 1982) and others may be present on the Promontory (P. Jackson pers. comm.). A single specimen has been recorded from the Otway region (Koehn and O'Connor in press). Previously listed as 'Restricted distribution or rare...', this species was placed in the vulnerable category by having small populations which occupy restricted habitats susceptible to

rapid environmental change. Populations of this species are also likely to have declined and are threatened by the further drainage of swamp areas. The presence of a population within a National Park was not considered an adequate safeguard for this species. As this species has a juvenile whitebait stage (Fulton 1986), a study of whitebait along the Victorian coast may reveal whether there are other populations of this species.

Australian Grayling *Prototroctes maraena*

The distribution and status of this species has been reviewed by Jackson and Koehn (1988) and its conservation status remains unchanged. Further details of spawning biology have been reported by Hall and Harrington (1989) and the upstream migration of a juvenile whitebait specimen has been recorded from the Otway region (Koehn and O'Connor in press). Despite such studies, precise details of spawning and early life history stages remain unknown. Because of the need for migration, this species is affected by barriers to fish passage. Large populations of this species occur in the Mitchell, Tambo and Barwon Rivers; all watercourses on which the construction of major storages have been considered. Records from most other locations are of small numbers of juvenile fish which do not necessarily indicate the presence of viable populations.

Silver Perch *Bidyanus bidyanus*

Previously listed as vulnerable, the status of Silver Perch remains unchanged. The species is reliably found in only a few localities, usually near the Murray River and these populations may be dependent on recruitment from Murray River populations. Barriers to fish passage caused by weirs and altered hydrological regimes below impoundments are likely to affect recruitment of this species.

Murray Cod *Maccullochella peeli*

Previously listed as vulnerable. The status of Murray Cod remains unchanged. The decline in abundance of this species (Cadwallader and Gooley 1984) is still of concern although few data are available on present population levels.

Freshwater Catfish *Tandanus tandanus*

Previously listed as Indeterminate, but recent surveys indicate good populations in only a few widespread locations. This species was once widespread, but has suffered substantial declines in range and abundance for unknown reasons. It has successfully been introduced into the Wimmera River, but this river is itself subject to major environmental problems (Anderson and Morison 1988).

POTENTIALLY THREATENED

Yarra pigmy perch *Edelia obscura*

This species has often been mistaken for Southern Pigmy Perch. Recent surveys in Western Victoria have added few new localities to the distribution of Yarra Pigmy Perch which was previously known from only a few areas. This species has also probably suffered population reductions due to habitat alteration. Previously listed as 'Restricted distribution or rare...'

Pouched lamprey *Geotria australis*

Adults of this species have rarely been encountered in Victoria. Most of the locality records are those of ammocoete larvae, which are difficult to identify to species level and in general have been found only in small numbers in coastal streams. This species is not abundant in Victoria, although it is widespread throughout the world. Its lifecycle is complex as oceanic conditions may determine its abundance. Previously listed as 'Indeterminate'.

Australian Bass *Macquaria novemaculeata*

This species is often confused with Estuary Perch (*Macquaria colonorum*). It is found only in east Gippsland where it is abundant in only a few localities. Australian Bass need clear fish passage to be able to migrate. Several rivers containing bass have been suggested for flow regulation and many catchments are subjected to logging. Previously listed as 'Restricted distribution or rare...'

Dwarf Galaxias *Galaxiella pusilla*

This species is reliant on swamp areas for habitats and distribution and abundance have undoubtedly declined because of wetland drainage. Populations sometimes fluctuate widely in response to environmental conditions and although the species is widespread in southern Victoria, there are few areas where it is common. Management recommendations have been made to protect several populations near to Melbourne (Koehn 1986a, 1986b). Previously listed as 'Indeterminate'.

Broad-finned Galaxias *Galaxias brevipinnis*

Trout pose a serious threat to many galaxiid species and as with the Mountain Galaxias, thriving populations of this species have been reported only in the absence of trout. Koehn and O'Connor (in press) suggest that the Broad-finned Galaxias may also be excluded from its preferred habitats by trout. Because this species has a marine life-phase juveniles returning from the sea need to migrate upstream. Although it can negotiate most barriers because of its remarkable climbing abilities, such barriers may impair its success. Because the species moves into the upper reaches of streams it is particularly prone to predation by trout as it passes through the more open lowland waters. Previously listed as 'Restricted distribution or rare..'.

Spotted Galaxias *Galaxias truttaceus*

As with the Broad-finned Galaxias, this species has a marine life phase and needs to be able to migrate upstream and is also prone to predation. Unlike the Broad-finned Galaxias however, this species has no extraordinary climbing skills and is substantially affected by barriers. Although widespread along the Victorian coast, few large populations have been found. Previously listed as 'Restricted distribution or rare..'.

Golden Perch *Macquaria ambigua*

Previously listed as vulnerable, recent surveys have increased knowledge of Golden Perch distribution. The past and present distribution of the species has recently been reviewed, and although releases of fry for angling purposes have expanded its range since 1975, its conservation status is still of concern (Brumley 1987). The species' range had previously been reduced, apparently by weirs which inhibit upstream movement of juveniles and adults, and populations below such weirs may be under threat from habitat alteration (Brumley 1987). It is considered to be more abundant and widespread than Murray Cod and Silver Perch which remain classified as vulnerable.

INDETERMINATE

Freshwater Blackfish *Gadopsis marmoratus*

The status of this species was not changed because the taxonomy of the genus *Gadopsis* remains under review. Two distinct types of *G. marmoratus* (southern and northern) have been referred to in recent works (Ovendon *et al.* 1988; Sanger 1986) and a new species will probably be described.

The description of *G. bispinosus* (Sanger 1984) and the documentation of distribution (Koehn in press) have lead to an effective reduction in the known range of *G. marmoratus* (northern). The upland streams where blackfish are most abundant in northern Victoria are now known to contain only *G. bispinosus* and there is now concern that because of low numbers of *G. marmoratus* (northern) in lowland streams this taxon may be classified as potentially threatened.

Although *G. marmoratus* (southern) may still be considered common and widespread south of the Great Dividing Range, concern has been expressed about the state-wide reduction in its range and abundance particularly in the reduction in the number of populations still containing large specimens of this popular

angling species. (Tunbridge and Glenane 1988; Koehn 1984).

Flat-headed Galaxias *Galaxias rostratus*

There has been no new information on the distribution and abundance of Flat-headed Galaxias. There are few localities where the species can be reliably collected and with further information it is likely to be listed as a threatened species. Its status remains unchanged.

Mountain Galaxias *Galaxias olidus*

Rich (1986) has described two groups of *G. olidus* populations (southern and northern/western) which may be sufficiently different to be listed as separate species. In addition, the Brown Galaxias was suggested as possibly qualifying as a subspecies and many other forms of *G. olidus* (e.g. high plains, lowland, coastal) have been recognised. The taxonomy of the *G. olidus* complex needs review and one or more of any new taxa described may fall into a threatened category. Indeed, *G. olidus* var. 'fuscus' has already been listed as endangered.

Cox's Gudgeon *Gobiomorphus coxii*

Previously listed as 'Restricted distribution or rare..'. The status of this species is uncertain partly because of possible confusion with the Striped Gudgeon. There are few confirmed records from Victoria where the species may be threatened.

Striped Gudgeon *Gobiomorphus australis*

Previously listed as 'Restricted distribution or rare..'. This species has been recorded only irregularly but its status is uncertain because of possible confusion with the apparently more common Cox's Gudgeon. Listed with Cox's Gudgeon until more reliable information on the status of these two species can be obtained.

Freshwater Hardyhead *Craterocephalus stercusmuscarum*

Previously listed as 'Restricted distribution or rare..', but recent surveys suggest its abundance and range may have declined. An infrequently collected species whose status is cause for concern, but for which good information is lacking.

Lake Eyre Hardyhead *Craterocephalus eyresii*

Previously listed as 'Restricted distribution or rare..'. Information on this species is lacking. Although probably never common or widespread, the species has recently been recorded only from a few saline lakes near Kerang. Attempts to collect this species from many sites described in earlier records in southern NSW have also been unsuccessful (W. Ivanstoff pers. comm.).

RESTRICTED

Two-spined Blackfish *Gadopsis bispinosus*

Two-spined Blackfish has only recently been described (Sanger 1984). Although abundant within its known range, this species is restricted to the upper reaches of streams in north-eastern Victoria (Koehn in press).

Bony Bream *Nematalosa erebi*

Previously listed as 'Indeterminate'. Recent surveys have indicated this species to be locally abundant in several lakes near the Murray River, particularly in the Kerang and Mildura areas. There is little evidence of a decline in its range or abundance. The species' distribution in Victoria is at the edge of its total range.

Crimson-spotted Rainbowfish *Melanotaenia fluviatilis*

Previously listed as Common and Secure. This species is relatively abundant in some areas (particularly billabongs and swamps along the lower Goulburn and Broken Rivers), but is not as widespread as was previously thought.

UNCERTAIN STATUS

Western Carp and Midgley's/Lake's Gudgeons

H. Klunzingeri and *Hypseleotris* spp.

These two undescribed species were not previously listed separately from the Western Carp Gudgeon. The three taxa of this species complex (Hoese *et al.* 1980)

are not easily distinguished in the field. All were considered common but until more specimens have been collected and records confirmed all three species should be listed as being of uncertain status.

Dwarf Flat-headed Gudgeon *Philypnondon* sp.

Previously listed as common and secure. This undescribed species may be easily confused with small specimens of the Flat-headed Gudgeon (Hoese *et al.* 1980). There are few confirmed records from Victoria and its present status is unclear.

Non-parasitic Lamprey *Mordacia praecox*

This species was recorded in the La Trobe River by Harasymiw (1983) and has been provisionally listed pending a verification of its identity.

Discussion

Although there has been an increase in our knowledge of the distribution and abundance of Victorian native freshwater fishes since the last review, the lack of information on many species noted by Cadwallader *et. al.* (1984) remains. Particular disappointment was expressed about the lack of systematic surveys and the gaps in distributional data. Such information is considered vital to determining the conservation status of any species. Compared to the effort expended on documenting the distribution of mammals and birds, the effort made to document fish distributions statewide has been minimal. Fauna surveys generally contain little or no information on fishes (e.g. Robertson *et al.* 1982; Chesterfield *et al.* 1983).

Distributional data for fish are generally compiled from the results of a variety of small surveys undertaken to monitor populations of angling species (e.g. Baxter 1985), assess results of stockings, determine environmental flow requirements (e.g. Tunbridge and Glenane 1988), or as a consequence of other short-term studies. There are few areas within Victoria where freshwater fish have been surveyed thoroughly: Wilsons Promontory (Jackson and Davies 1983a), the Otway region (Koehn and O'Connor in press), the Grampians (Jackson and Davies 1983b), Western Port catchment (Koehn 1986a) and Seven Creeks (Cadwallader 1979; Morison and Anderson 1987), and generally, subsequent surveys have not been conducted.

East Gippsland, the Western districts, north and north-western Victoria are highlighted as areas in particular need of comprehensive fish surveys. Most information is available for sportfish and more attention must be paid to the collection of information on smaller, non-angling species, particularly in northern Victoria. The lack of a computer database for storage of fish distribution information and the lack of comprehensive specimen collection to help overcome problems in taxonomy and identification were also noted.

Steps must be taken to overcome the obvious deficiencies in distributional and abundance data for fish species in Victoria. Priority should be given to comprehensive surveys to determine whether or not the Southern Purple-spotted Gudgeon and Agassizis Perch still occur in Victoria. Similar surveys must be undertaken to determine the distribution of Freshwater Herring, Ewens Pigmy Perch and Brown Galaxias, all of which have received little attention. Their endangered status emphasises the need for special management measures to be undertaken if these taxa are to survive. All taxa in the Indeterminate and Uncertain status categories need further study.

In a recent review of the conservation status of small freshwater fish in the River Murray in South Australia, Lloyd and Walker (1986) also expressed concern at the lack of data available for non-angling species and at the decline of fish numbers and hence reductions in genetic diversity. They regarded four species, Agassizis Perch, Southern Purple-spotted Gudgeon, Southern Pigmy Perch and Freshwater Blackfish (northern), as being endangered in the lower Murray River.

The list of freshwater fish species used for this review was based on the listing used by Cadwallader *et al.* (1984). Although several taxa were added, other species are likely to be present in Victoria. Several species of gudgeons and gobies may be present in Victoria but to date have not been identified or described. The Mangrove Goby *Mugilogobius palidus* has recently been reported from Western Port catchment (R. Kuiter pers. comm.). Several marine species e.g. Yellow-eye Mullet *Aldrichetta forsteri* are also often found in freshwater, but were not considered relevant for discussion.

Although thirteen species have been considered to be 'common and/or widespread', these species should not be considered secure. Concern was expressed that all species need to be monitored to determine population changes and that efforts must be made to prevent species from moving into more threatened categories. Threats to fish species (see Koehn and O'Connor 1990) may continue to operate regardless of the conservation status of the species involved unless management steps are taken to alleviate such problems.

Even though a species may be widespread or abundant, extinction or reductions of populations may occur in localised areas. For example, Southern Pigmy Perch are widespread in southern Victoria, but north of the Great Dividing Range its distribution is very patchy and it has been considered as endangered in the lower reaches of the Murray River (Lloyd and Walker 1986). Such changes may be important warning signs to the deterioration of a species' conservation status, and abundant species may rapidly be forced into threatened categories.

This conservation listing, together with recommendations for Victorian species was presented to the Australian Society for Fish Biology Threatened Fishes committee at its annual meeting on 25 August 1989. As a result, Ewens Pigmy Perch and Yarra Pigmy Perch have been added to the categories of Vulnerable and Potentially threatened respectively. Other Victorian species listed in threatened categories include: Trout Cod - Endangered and Non-parasitic Lamprey and Australian Grayling - Vulnerable. Macquarie Perch and Catfish were nominated for special investigation (J. Harris, unpub. data).

The reviewers emphasise that this list is dynamic and any changes to a threatening process for a species can lead to a review in its status at any time. As suggested by Cadwallader *et al.* (1984), it is intended that the entire list be revised every five years, although changes may be made in the interim if necessary.

It is hoped that this revision of the conservation status listing will assist with the determination of conservation priorities, Flora and Fauna Guarantee listings and management strategies for native freshwater fish in Victoria.

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A new locality for the Two-spined Blackfish (*Gadopsis bispinosus*) outside Victoria

Mark Lintermans and Terry Rutzou*

The Family Gadopsidae is endemic to fresh waters of southeastern Australia and currently contains two species, the River Blackfish *Gadopsis marmoratus* and the recently described Two-Spined Blackfish *Gadopsis bispinosus* (Sanger 1984). A third species of *Gadopsis* proposed by Parrish (1966) was not warranted on morphological grounds (Sanger 1984).

As *G. marmoratus* was considered to be the only species of blackfish prior to 1984, the pre-1984 literature records this species as widely distributed throughout Tasmania and southeastern mainland Australia, extending as far north as the Condamine River in Southern Queensland (Jackson and Llewellyn 1980). The description of *G. bispinosus* means that the pre-1984 distribution of blackfish needs re-examination to determine exactly which species is present. In the field *G. bispinosus* can be distinguished from *G. marmoratus* by a white outer edge on the dorsal, anal and caudal fins and by the presence of only two (range 1-3) dorsal fin spines instead of 11 (range 6-13) in *G. marmoratus*.

As part of an ongoing fish survey of waters in the Australian Capital Territory, sampling was carried out in the Upper Cotter River catchment above Bendora Dam in the western ACT in 1988-89 (Fig. 1). Blackfish in this river system always had been assumed to be *G. marmoratus* (Shorthouse 1979; National Capital Development Commission 1984, 1986). However, all the blackfish recorded from the Cotter Catchment during this survey were *G. bispinosus* with no *G. marmoratus* detected.

The Cotter River above Bendora Dam is part of the Namadgi National Park which contains 94,000 ha of mostly bushland in the southern ACT (Fig. 1). In an effort to conserve native fish and their habitats, fishing is prohibited in the Cotter River catchment above Bendora Dam. Consequently the Two-spined Blackfish is totally protected within its known range in the Namadgi National Park.

Gadopsis bispinosus has only been recorded from a number of localities in Victoria (Sanger 1984, 1986; Koehn 1987) and this is the first record of the species outside that State. In Victoria it is confined to the north-eastern tributaries of the Murray River, north of the Great Dividing Range (Ovenden *et al.* 1988) and appears to prefer cool clear rocky-bottomed mountain streams. The Cotter River fits this description well.

Anecdotal angler reports indicate that blackfish were caught in the adjacent Naas-Gudgenby catchment and the Murrumbidgee River (Fig. 1) as recently as the late 1960s (Greenham 1981) but recent surveys have not recorded blackfish in either of these systems in the ACT. Whether these reports were of *G. marmoratus* or *G. bispinosus* is unknown. Both of these river systems are warmer, more turbid, and at lower altitudes than the Cotter River and as such may have been more suited to *G. marmoratus*.

There are many streams and impoundments surrounding the ACT which are reported to contain blackfish but the identity of the species present is not known and warrants further investigation. It would not be surprising to find *G. bispinosus* has a much wider distribution in this area.

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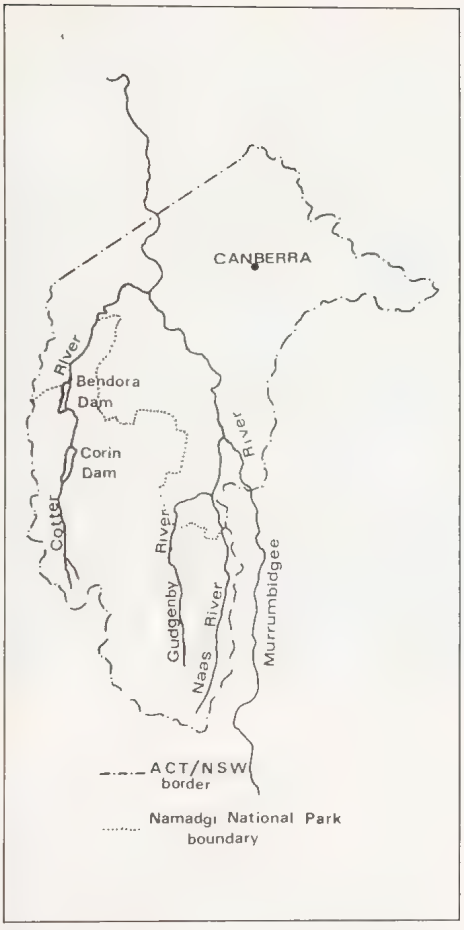

Fig. 1. Map of the ACT showing Namadgi National Park and river systems mentioned in the text.

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A species list for the Merri Creek area (Melbourne, Victoria) compiled in 1896.

Ian Clarke*

Introduction

The accompanying list of plant species of the Merri Creek area near North Coburg and Campbellfield (suburbs of Melbourne) was compiled in 1896 by H. M. R. Rupp (1872-1956), then a young man pursuing theological studies at the University of Melbourne. Rupp was born at Port Fairy in south-western Victoria, and his early interest in wild flowers was later fostered by J. Bracebridge Wilson, an uncle by marriage and headmaster of Geelong Grammar School which Rupp attended between 1883 and 1891. Bracebridge Wilson (1828-1895) is probably best remembered in botanical circles for his contributions to the study of marine algae.

Rupp pursued his botanical hobby with enthusiasm throughout his life and became one of the foremost orchid experts of his time. He published some 215 articles, and two books on the orchids of NSW (Willis 1956). From these, as well as the voluminous correspondence that he left behind, it is obvious that he was a careful observer and a meticulous recorder of his observations. Throughout his career in the ministry Rupp compiled catalogues of the plants that occurred in the various parishes in which he was stationed. Today, these lists form valuable early records of the plant life of these regions. Most of his time was spent in NSW, but six catalogues exist for areas of Victoria : Coleraine district (1892), Wando Vale (1892), Buninyong (1896), Kingston (c. 1896), Merri-Merri Creek (North Coburg, Campbellfield and district, 1896), and Beeac and adjoining localities (1898). Copies of these lists are held in the library of the National Herbarium of Victoria.

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With increased attention in recent years being focussed on the original flora of urban areas, Rupp's Merri Creek list has become a record of particular interest.

The list is obviously not exhaustive. The grasses, sedges and rushes, for example, are entirely omitted. Rupp was aged 24 at the time and although his botanical training was thorough, few students of natural history come to grips with these groups without considerable study. Rupp himself acknowledges his ignorance, suggesting in the Wando Vale catalogue that these groups must await the 'opportunity for more detailed study'. He was obviouly aware of his limitations and this enhances confidence in the accuracy of the existing records.

Rupp's botanical training began at a relatively early age. Many years later he recorded that he began collecting specimens of wildflowers at the age of seventeen when a boarder at the Geelong Grammar School (Rupp 1926). Bracebridge Wilson was instrumental in Rupp's early training. He encouraged Rupp, as well as other boys at the School, to use Mueller's *Key to the System of Victorian Plants* (1888) which Rupp later recalled was heavy going! (L. A. Gilbert, pers. comm.). Wilson had published a small booklet on the flora of the Geelong district in about 1889 which included descriptions of several day trips that could be undertaken to see the local plants at their best. This may well have influenced and encouraged Rupp to follow his example.

At the University of Melbourne Rupp studied biology and systematic botany, as well as systematic zoology, and won the Wyselaski Scholarship for Natural Science in December 1896. Much of his spare time was spent in botanical exploration in the

Merri Creek today.

'wilds' of the suburbs. He later recorded however that his most memorable holiday was to the Riverina in NSW when he stayed with his sister at Hay during the summer of 1894-5 (Rupp 1926). Following this trip he corresponded with Ferdinand Mueller (1825-1896) whom he had visited previously and who assisted the young botanist to identify the many unfamiliar plants that he had discovered. Many years later (in December 1925) he was to donate a substantial plant collection to his old university; specimens still exist from these early years such as *Drosera glanduligera* collected at Mentone in September 1892 or *Viola betonicifolia* from Mordialloc in October of the same year.

Rupp was obviously familiar with the standard botanical texts of the time. One of his illustrations in the Wando Vale catalogue is cited as being 'after Dendy and Lucas (1892)', which was a teaching text written for Australian botany students by two of Baldwin Spencer's staff. Spencer was then Professor of Biology at the University. Rupp also says in the Beeac catalogue that the nomenclature he used followed Mueller's *Key to the System of Victorian Plants* (1888), and this order is also followed in the Merri Creek list. For the keen student of the local flora, there were a number of contemporary texts available, largely due to the efforts of Mueller. As well as that cited above, these included his *Introduction to botanic teachings at the schools of Victoria* (1877), and *The native plants of Victoria succinctly defined* (part 1, 1879). Other works included Bentham's *Flora Australiensis* (1863-78), and a volume of paintings of local species by Fanny Charsley (1867) that was dedicated to Mueller.

It is interesting to see that some 70 of the 116 species recorded by Rupp are not included in a recent list in the booklet *Plants of the Merri Merri* published by the Merri Creek Co-ordinating Committee (1984), even though the latter encompasses

a much wider geographic range and could be expected to be reasonably comprehensive. Presumably these are the species that have suffered most from disturbance and competition in the intervening years. A similar number of species noted by Rupp are not recorded in a list for nearby Studley Park and Yarra Bend Reserve published by McIntyre and Yugovic (1982) and later updated by Willis (1984). Over 50 of Rupp's records (here marked #) are not in either of these lists.

For further details of Rupp's life and work see Clarke (in press), Gilbert (1988) and Willis (1956). The booklet *Plants of the Merri Merri* includes information about the history of the region as well as describing the indigenous vegetation.

In the following list, an attempt has been made to update the names of Rupp to conform to Forbes and Ross (1988). Where the name used by Rupp is different, this is placed in parentheses after the current name. A few names could not be satisfactorily updated; in the absence of voucher specimens it is sometimes impossible to trace a record through the mire of taxonomic revisions and nomenclatural changes. Some problems have been noted in the list, but there may still be records that should be viewed with caution, for example where only one species was known at the time and several are now recognised (e.g. *Acaena ovina*). Rupp did not include authorities for his names.

For convenience, the list is here arranged in alphabetical order of families within the major groups – Dicotyledons, Monocotyledons and Ferns. An asterisk preceding a name indicates that this is now considered an introduced species.

H. M. R. Rupp (1896) Catalogue of Plants, Merri-Merri Creek. (North Coburg and District), Victoria.

DICOTYLEDONS

AIZOACEAE (FICOIDEAE)

Carpobrotus rosii
(Mesembrianthemum aequilaterale)
[*C. modestus* is recorded for Studley Park and Yarra Bend Reserve and is more likely to be the species that Rupp observed. *C. rossii* is now recognised as a coastal species; *C. modestus* had not then been described.]

AMARANTHACEAE (AMARANTACEAE)

 # Alternanthera denticulata
(A. triandra)
Ptilotus spathulatus

APIACEAE (UMBELLIFERAE)

 # Centella cordifolia (Hydrocotyle asiatica)
 # Daucus glochidiatus (D. brachiatus)
Eryngium ovinum (E. rostratum)
 # E. vesiculosum
 # Hydrocotyle laxiflora (H. candollei)

ASTERACEAE (COMPOSITAE)

 # Brachyscome cardiocarpa
 # B. decipiens
 # B. spathulata (B. scapiformis)
[*B. scapiformis* was considered by Davis (1948) to be part of the *B. aculeata* complex which has presented considerable taxonomic difficulties. Stace (1981) reduces *B. scapiformis* to synonymy under *B. spathulata*, as a species distinct from *B. aculeata*]
Cotula australis
C. coronopifolia
 # Craspedia glauca (C. richea)
 # Cymbonotus lawsonianus
[Rupp most likely saw what is now called *C. preissianus*. Mueller (1888) and Bentham (1866) included only *C. lawsonianus* which is now considered to be localized in the NW Mallee and the E Highlands (Willis 1973.)]

Gnaphalium involucratum sens. lat.
(G. japonicum)
Helichrysum apiculatum
H. dendroideum (H. ferrugineum)
Leptorhynchos squamatus
Pseudognaphalium (Gnaphalium) luteo-album
Sigesbeckia orientalis
Triptilodiscus pygmaeus (Helipterum dimorpholepis)
Vittadinia cuneata (V. australis)

BORAGINACEAE (ASPERIFOLIAE)
Myosotis suaveolens

BRASSICACEAE (CRUCIFERAE)
Cardamine sp. (C. parviflora)
[This could be one of a number of species currently recognised including the native *C. paucijuga* and *C. flexuosa*, or the weedy *C. hirsuta*.]

BRUNONIACEAE (included in GOODENIACEAE)
Brunonia australis

CAMPANULACEAE
Isotoma fluviatilis
Wahlenbergia gracilis
[Early authors, e.g. Mueller (1888), and even up to Ewart (1931), give *W. gracilis* as the only species of *Wahlenbergia* occurring in Victoria. It is impossible to be sure which of the current species is intended.].

CARYOPHYLLACEAE (CARYOPHYLLEAE)
Stellaria pungens

CASUARINACEAE (CASUARINEAE)
Allocasuarina verticillata (Casuarina quadrivalvis)

CHENOPODIACEAE (SALSOLACEAE)
Einadia nutans (Rhagodia nutans)

CLUSIACEAE (HYPERICINAE)
Hypericum japonicum

CONVOLVULACEAE
Convolvulus erubescens
Dichondra repens

CRASSULACEAE (SAXIFRAGEAE)
Crassula sieberiana (Tillaea verticillaris)

DROSERACEAE
Drosera peltata ssp. auriculata (D. auriculata)
D. peltata ssp. peltata (D. peltata)
D. whittakeri

FABACEAE (included in LEGUMINOSAE)
Bossiaea prostrata
Glycine clandestina
G. tabacina
Hardenbergia violacea (Kennedya monophylla)
Indigofera australis
Kennedia prostrata

GENTIANACEAE (GENTIANEAE)
* *Centaurium spicatum (Erythraea spicata)*

GERANIACEAE
Geranium solanderi (G. pilosum)
Pelargonium australe

GOODENIACEAE
Goodenia geniculata
G. ovata

HALORAGACEAE (HALORAGEAE)
Myriophyllum sp. (M. variifolium)
[Rupp's *M. variifolium* (= *M. propinquum* of Willis, 1973) is now recognised as four distinct species (Forbes and Ross, 1988). Of these, *M. crispatum* and *M. simulans* are the most likely species to have occurred in the region (Orchard 1986).]

LAMIACEAE (LABIATAE)
Ajuga australis
Mentha australis
Scutellaria humilis

LINACEAE (LINEAE)
Linum marginale

LORANTHACEAE
 # Amyema pendulum (Loranthus pendulus)

LYTHRACEAE (SALICARIEAE)
 # Lythrum hyssopifolia

MIMOSACEAE (included in LEGUMINOSAE)
Acacia acinacea
A. implexa
A. mearnsii (A. mollissima)
A. melanoxylon
A. paradoxa (A. armata)

MYOPORACEAE (MYOPORINAE)
Myoporum viscosum

MYRTACEAE
Eucalyptus camaldulensis (E. rostrata)
E. viminalis
Leptospermum lanigerum

ONAGRACEAE (ONAGREAE)
 # Epilobium billardierianum (E. glabellum)

OXALIDACEAE (included in GERANIACEAE)
 # Oxalis corniculata
[This is now considered to be a species aggregate in Australia with both native and introduced species involved (Thompson 1982).]

PITTOSPORACEAE (PITTOSPOREAE)
Bursaria spinosa

PLANTAGINACEAE (PLANTAGINEAE)
Plantago varia

PROTEACEAE
Grevillea sp. (G. floribunda)
[A polymorphic 'species' which included at least the currently recognised *G. chrysophaea* and *G. polybractea,* neither of which are likely in the area. *G rosmarinifolia* is recorded in 'Plants of the Merri Merri' (1984).]

RANUNCULACEAE
Clematis microphylla
Ranunculus lappaceus
 # R. plebeius (R. hirtus)

ROSACEAE
Acaena anserinifolia (A. sanguisorbae)
A. ovina
Rubus parvifolius

RUBIACEAE
Asperula sp. (A. oligantha)
[Three current species were included under this name – *A. conferta, A. pusilla,* and *A. scoparia* (Ewart 1931). Of these, *A. conferta* is recorded by McIntyre and Yugovic (1982).]
 # Galium australe

RUTACEAE
Correa sp. (C. speciosa)
[This name was applied to a wide range of material that is now recognised as a number of different taxa (Wilson 1961). The species most likely to have occurred in the area are *C. glabra,* recorded in Plants of the Merri Merri (1984), and *C reflexa.*]

SANTALACEAE
Exocarpos cupressiformis

SCROPHULARIACEAE (SCROPHULARINEAE)
 # Limosella australis (L. aquatica)
Veronica gracilis

SOLANACEAE
** Solanum nigrum*
Nicotiana suaveolens

STACKHOUSIACEAE (STACKHOUSIEAE)
 # Stackhousia monogyna (S. linarifolia)

STYLIDIACEAE (CANDOLLEACEAE)
 # Levenhookia dubia (Leewenhoekia dubia)

 # Stylidium despectum (Candollea despecta)

THYMELAEACEAE (THYMELEAE)
Pimelea curviflora
P. humilis

VIOLACEAE
Hymenanthera dentata (H. banksii)
 # Viola betonicifolia
 # V. hederacea

ZYGOPHYLLACEAE (ZYGOPHYLLEAE)
 # Zygophyllum billardieri

MONOCOTYLEDONS

JUNCAGINACEAE (FLUVIALES)
Triglochin procera
 # T. striata

LILIACEAE
 # Arthropodium milleflorum (A. paniculatum)
Bulbine bulbosa
Burchardia umbellata
 # Chamaescilla corymbosa
Dianella revoluta
 # Hypoxis glabella (in family AMARYLLIDEAE)
 # Thysanotus patersoni
Wurmbea dioia

ORCHIDACEAE (ORCHIDEAE)

Corybas dilatatus (Corysanthes pruinosa)
[*Corysanthes pruinosa* is now considered endemic to NSW (Jones 1988, as *Corybas pruinosus*) but was the only species recorded for Victoria by Mueller (1888). It is not synonymous with *Corybas dilatatus* (Clements 1982) but the latter seems most likely to be the species that Rupp observed. The name *Corysanthes pruinosus* had been misapplied to *Corybas dilatatus* by several authors in the past Willis (1970: 398).]
Diuris lanceolata (D. pedunculata)
 # Microtis unifolia (M. porrifolia)
 # Pterostylis mutica
 # P. curta
 # P. cucullata
[Rupp placed the name *P. mackibboni* in parentheses after this entry]

POTAMOGETONACEAE (FLUVIALES)
 # Potamogeton ochreatus (P. obtusifolius)
[Rupp included a further *'P.'* here, perhaps indicating another, unidentified, species of Potamogeton.]

FERNS [Rupp included all ferns under the heading FILICES)

ADIANTACEAE
 # Adiantum aethiopicum
Cheilanthes sp. (C. tenuifolia)
[A number of taxa have been recognised as distinct from *C. tenuifolia* (Quirk et al. 1981). Of these *C. austrotenuifolia* seems the most likely to have occurred in the area.]
 # Pellaea falcata (Pteris falcata)

ASPLENIACEAE
 # Asplenium flabellifolium

DENNSTAEDTIACEAE
Pteridium esculentum (Pteris aquilina)

GRAMMITIDACEAE
Pleurosorus rutifolius (Grammitis rutifolia)

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President's Picnic 1989

The President's Picnic was held on 3 December, and about 35 members enjoyed a visit to the Point Nepean National Park. The new national park has a total area of 2200 hectares, incorporating the former Cape Schanck Coastal Park (40 km of ocean coastline between Flinders and Portsea), the southern section of the former Nepean State Park, and 200 hectares of Commonwealth land at Point Nepean which were transferred to the State of Victoria in 1988.

An overcast morning developed into a warm sunny afternoon, tempered by a south-westerly breeze. After lunch in the picnic area adjacent to the car park, and an inspection of the Orientation Centre, we boarded the Transporter. This consists of five open boxlike carriages, each accommodating twelve passengers, pulled by a tractor. The Transporter runs at half-hourly intervals, and access to the park is strictly controlled, because of the fragility of the environment, and the dangers of the area. Much of the park is still Commonwealth property, fenced and conspicuously marked with warning signs about unexploded shells, and other military detritus. Walking is prohibited for the first few kilometres, as far as Cheviot Hill, though there is a scheduled stop at the cemetery before this. Unfortunately the cemetery is closed until the new year, so we were unable to inspect it.

Climbing Cheviot Hill (54 m) gave us an excellent view over the coastline, Port Phillip Bay, and in particular Cheviot Beach, so called from the wreck of the "Cheviot" in 1887. Beyond the fence are the wooden benches built for people who attended the memorial service for Harold Holt who disappeared while swimming here in 1967. Considerable erosion was caused on Cheviot Hill by clearing of vegetation during World War II, and work is in hand to encourage regrowth of native plants. The dominant vegetation here is *Melaleuca lanceolata, Leptospermum laevigatum, Leucopogon parviflorus* and the introduced purple-flowered *Polygala.* Records indicate that before European settlement the vegetation consisted of open woodland of *Casuarina stricta* and *Melaleuca lanceolata* with grassy clearings. In places along the route the elegant outline of a lonely *Casuarina stricta* gave some impression of what the area must once have looked like.

We continued on to Point Nepean, past decaying barracks, which it is hoped may be restored and converted into an education centre for the park. Fort Nepean was the major fortified area at Point Nepean from 1882 to 1945, and we were able to inspect all the gun emplacements, with various types of guns, and to admire the quality of the brickwork throughout, but especially in the main tunnel and the shafts connecting to the ammunition magazine. Going through the Engine House and down to the lower level brought us to the site of the Engineers' barracks and the jetty, where the supply boat from Queenscliff regularly arrived.

The return journey in the Transporter at a leisurely 20 kph afforded us some spectacular views of the coastline and bay.

It was an enjoyable day, and we thank Graeme Love for his choice of venue for the 1989 President's Picnic.

Sheila Houghton

Prophetic Words

"But perhaps the most interesting of the younger associations is that of the Field Naturalists, whose main delight it is to go abroad in company, to visit such districts as are likely to yield a harvest to the devotees of the hammer, of the net, or of the dredge; to the collector of plants or the sticker of insects. Their most notable ramble was that in which they were landed from a steamer on King's Island, and overhauled that isolated region to carry back their various trophies of fauna, or flora, or mineralogy. The monthly evening meeting of these Field Naturalists is full of interest; each is so zealous about his own department, and all contribute so largely to the store of exhibits that crowd the tables. From these amateur enthusiasts there ought to spring the material for excellent research in future years."

From 'Victoria and Its Metropolis: Past and Present', (1888).

November Meeting Report

The November Meeting was the 50th Anniversary of the Australian Natural History Medallion. Sheila Houghton (Vice-President FNCV) presented a most interesting talk on the history of the award. This history will be featured in a special article later this year.

Professor Tony Lee, Vice-President of the Royal Society of Victoria, then presented Bruce with the Medallion accompanied by a speech on Bruce's many achievements. Sheila Houghton has written up Bruce's story on pages 260-61 of the November/December issue.

Bruce then thanked all his well-wishers with a speech noting those that had been the major influences in his life including the late Gordon Beaton, Jim Willis, Cliff Beauglehole, George Scott, Christine McGargill, Margaret Clayton, Golda Isaac, Betty Duncan, Christine Ashburner and Tom May. Bruce then showed us a selection of his magnificent slides.

The Eds.

100 Years Ago
The Tall Trees of Victoria

In a paragraph in the *Victorian Naturalist* for February last (vol. v, page 152) reference is made to a giant tree said to exist in the Dandenong Ranges. Since the paragraph appeared considerable correspondence has taken place in the press on the subject, and careful measurements of several reputed giant trees have been taken. The one previously mentioned has thus been reduced to 220 feet high and 48 feet 6 inches in circumference at 6 feet from the ground. However, in the same locality, one was measured 271 feet high, but with smaller girth. Mr G. S. Perrin, F.L.S., Conservator of Forests, published a tabulated statement of the tall trees of Victoria in the *Argus* of 11th June, 1889, from which it appears a height of 480 feet is claimed for a tree on the Black Spur (Mr W. Ferguson); 470 feet for one at Mount Baw Baw (Mr G. W. Robinson); 415 feet for one in Cape Otway forest (Mr C. Walter); and 392 feet for one near Fernshaw (Mr C. Walter), but these measurements require further verification.

Anon., *The Victorian Nat.* Vol. 6, Sept. 1889, p.88.

EDITORIAL POLICY

Title

The Victorian Naturalist is the bimonthly publication of the Field Naturalists Club of Victoria.

Scope

The Victorian Naturalist publishes articles on all facets of natural history. Its primary aims are to stimulate interest in natural history and to encourage the publication of articles in both formal and informal styles on a wide range of natural history topics.

Research Report

A succinct and original scientific communication. Preference is given to reports on topics of general interest.

Contributions

Contributions may consist of reports, comments, observations, survey results, bibliographies or other material relating to natural history. The scope is broad and little defined to encourage material on a wide range of topics and in a range of styles. This allows inclusion of material that makes a contribution to our knowledge of natural history but for which the traditional format of scientific papers is not appropriate.

Naturalist Notes

Short and informal natural history communications. These may include reports on excursions and talks.

Commentary

Informative articles that provide an up-to-date overview of contemporary issues relating to natural history. Whilst commentary articles are invited, the editors welcome discussion of topics to be considered for future issues.

Book Reviews

Priority is given to major Australian publications on all facets of natural history. Whilst reviews are commissioned, the editors welcome suggestions of books to be considered for review.

News

Any items of news concerning the FNCV.

Diary

Notice of coming events including activities of FNCV groups and any other activities of interest to *Vic. Nat.* readers.

Review Procedures

Research reports and Contributions are submitted to the editors and are forwarded to the appropriate member of the editorial board for comment. All research reports are assessed by two independent qualified referees prior to publication. Contributions are assessed by the appropriate member of the editorial board and may be refereed at the editors discretion. All other articles are subject to editorial review.

GUIDELINES FOR CONTRIBUTORS

Submission of Manuscripts

The following general statements apply to all submitted manuscripts.

Three copies of the manuscript should be provided, each including all tables and copies of figures. Manuscripts should be typed, double spaced with wide margins and pages numbered. The name and address of all authors should appear beneath the paper title. The full postal address, telephone number and fax number (if available) of the author who is to receive correspondence and check the proofs should be provided.

Abbreviations and Units

SI units (metre, kilogram, etc.) should be used wherever possible. Statistics and measurements should be given in figures (i.e. 10 mm) except where the number beings a sentence. When a number does not refer to a unit of measurement it is spelt out, unless the number is greater than nine. The word 'figure' should be abbreviated to Fig. unless starting a sentence.

Tables and Figures

All illustrations (including photographs) are considered as figures. All figures should be referred to in the text. Original figures or high quality photographic copies should be provided with the manuscript. Each figure should bear the figure number and authors name on the back in pencil. Line drawings should be in black Indian ink on stout white paper or high quality tracing paper. Lettering should be added bearing in mind legibility after reduction. Bar scales are preferred to numerical scales. Figure captions should be numbered consecutively (Fig. 1, Fig. 2, etc.) and provided on a separate page at the end of the manuscript.

Tables should be numbered consecutively (Table 1, Table 2, etc.) and should have an explanatory caption at the top. The presentation of the same data in both tabular and graphical form should be avoided. Tables and figures should be designed to fit within a page width (115 mm) or a column width (55 mm) following reduction.

References

References should be cited in the text by author and year and listed at the end of the text in alphabetical order and in the following form:

Ashton, D. H. (1976). Phosphorus in forest ecosystems at Beenak, Victoria. *Aust. J. Ecol.*, **64**: 171-86.

Gill, A. M. (1981). Adaptive responses of Australian vascular plant species. *In* 'Fire and the Australian Biota'. Eds A. M. Gill, R. H. Groves and T. R. Noble, pp. 243-72. (Australian Academy of Science: Canberra).

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Titles of journals should be abbreviated according to the most recent (4th) edition of the World List of Scientific Periodicals (available at most libraries).

Other methods of referencing (e.g. footnotes) may be acceptable in manuscripts other than research reports. The editors should be consulted prior to the submission of a manuscript that uses a method other than author-date.

Research Reports

A research report is a succinct, formal, original scientific communication. Preference will be given to reports that make a significant contribution to natural history literature and are of general appeal. The manuscript should consist of an abstract not exceeding 250 words, an introduction, methods, results, discussion, acknowledgements and references.

Contributions and Naturalist Notes

The general comments on figure and table presentation, referencing and units also apply to these manuscripts. The appropriate style and format will vary with the manuscript but concise simple English should be used at all times. The use of subheadings is encouraged where they improve comprehension.

Friday 13th – Sunday 16th April
Neds Corner, Mallee.

Saturday 21st – Sunday 2nd April
Water Rats, Werribee,

Botany Group

The group contact is Miss Margaret Potter (Phone 299 2779).

Meetings

8 p.m. on the **second Thursday** of the month, National Herbarium.

Thursday 8th February
Talk by the well known botanist Helen Aston titled "Aquatic plants in Australia – their morphology, taxonomy, distribution and impact on the environment".

Thursday 8th March
Talk by David Albrecht, from the National Herbarium, on the flora of Borneo and North Sumatra.

Thursday 12th April
A panel of members will talk on the theme "Autumn in the bush – Fruits and Flowers".

Excursions

Saturday 24th February
Aquatic plants excursion. Possibly in the Seymour area.

Saturday 24th March
"Mountain fruits and trees". An excursion to Mt Donna Buang. Leader Hilary Weatherhead.

Saturday 28th April
"Six zones of coastal plant associations". An excursion to Tyabb, Hastings and Crib Point, Leader Stefanie Rennick.

Microscopical Group

The group contact is Mrs Elsie Graham (Phone 469 2509).

Meetings

8.00 p.m. on the **third Wednesday** of the month at **The Astronomers Residence,** Birdwood Avenue, South Yarra.

Wednesday 21st February
How to use a microscope. How to illuminate an object to get the best result.

Wednesday 21 March
A talk by Mr P. E. Bock titled "Bryozoa or Polyzoa – What are they?".

Wednesday 18th April
The Scanning Electron Microscope – How does it work? There will also be a display fo S.E.M. photographs.

The Hawthorn Junior Field Naturalists Club

Meetings at 7.30 p.m., **last Friday** in the month at Balwyn Primary School, corner of Balwyn and Whitehorse Roads, Balwyn. Contacts are Jonathon Stevenson (830 5886) or Rohan Clarke (725 8923).

Friday 23rd February
Mutton Birds.

Friday 30th March
Easter camp at Lower Glenelg.

Field Naturalists Club of Victoria

In which is incorporated the Microscopical Society of Victoria

Established 1880

Registered Office: FNCV, c/ National Herbarium, Birdwood Avenue, South Yarra, 3141.

OBJECTIVES: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron

His Excellency, The Rev Dr John Davis McCaughey, The Governor of Victoria.

Key Office-Bearers 1988-1989

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Vice President: Mrs. SHEILA HOUGHTON, FNCV, National Herbarium, Birdwood Avenue, South Yarra, 3141 (551 2708)

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Geology: Miss HELEN BARTOSZEWICZ, 16 Euroa Avenue, Nth. Sunshine, 3020 (311 5106 A.H.)

Fauna Survey: Mr. JULIAN GRUSOVIN, 1 Warriner Court, East Oakleigh, 3166. (543 8627).

Microscopical: Mrs. ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1990

Metropolitan members (03 area code)	$27
Joint Metropolitan	$30
Country/Interstate members	$24
Joint Country/Interstate members	$27
Concessional rate (Students/pensioners) (proof of entitlement required)	$20
Joint Concessional	$23
Junior (under 18; No Victorian Naturalist)	$5
Clubs	$25
Subscription to Victorian Naturalist	$30
Overseas subscription to Victorian Naturalist	$35 Aust.
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The Victorian Naturalist

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FNCV DIARY

General Meetings

Held on the **second monday** of the month (except for public holidays), 8.00 p.m. at the National Herbarium, corner of Birdwood Avenue and Dallas Brooks Drive, South Yarra. Meetings include a talk by a guest speaker. All members of the public are welcome.

Monday 9th July

Monday 10th September

Monday 13th August

FNCV Excursions

Special notice: some excursions will be held on Saturdays since public transport is more frequent than on Sundays. For details of excursions contact Dorothy Mahler (Ph. 850 9379 after 6.00 p.m.).

Sunday 1st July

Zoological gardens. Meet at the Royal Park entrance at 10.30 a.m. Catch the No. 68 tram from Elizabeth Street Terminal (runs about every 30 mins., 9.40, 10.11).

Sunday 5th August

Blackburn Lake. Meet at Blackburn Station at 10.30 a.m. Catch 10.03 a.m. train at Flinders Street Station.

Group Activities

Fauna Survey Group

Meetings (First Tuesday in the month)

Tuesday 3rd July

Tuesday 7th August

Botany Group

Group Meetings (Second Thursday)

Thursday 12th July

Mosses. Arthur Thies.

Thursday 9th August

From Dalhousie to Western Queensland. Margaret Corrick.

Thursday 13th September

Excursions

Saturday 28th July

Mosses. Warburton area. Leader Arthur Thies.

Saturday 25th August

Cranbourne annexe of the Royal Botanic Gardens. Leader to be arranged.

Geology Group

Group Meetings (First Wednesday)

Wednesday 4th July

Wednesday 8th August

Microscopical Group

Group Meetings (Third Wednesday)

Wednesday 18th July

Collecting plankton.

Wednesday 15th August

Polarised light and the microscope.

Wednesday 19th September

Pollen slides. Members to make and display.

Hawthorn Juniors

Group Meetings (Last Friday)

Friday 27th July

Alpine Wildlife.

Friday 31st August

To be arranged.

Contacts: Gerard Marantelli 497 2281
Peter Kelleher 337 6405

The Victorian Naturalist

Volume 107 (2) April, 1990

Editors: Tim Offor and Robyn Watson.

F.N.C.V.

ISSN 0042-5184

Cover photo: Derrimut Grassland Reserve under a previous management regime. (See research report on p. 45). Photo: Keith McDougall.

From the Editors

One of the challenges facing us as the editors of a natural history journal with a scope as wide as *The Victorian Naturalist* is arriving at an editorial style that is both straightforward to read and is in general agreement with the standards of the major schools of natural history (possibly a case of you can't please all the people all the time . . .)

Common names are a case in point. Common names (those used in common by most people) are not to be confused with vernacular names which are used in particular regions. Many of the specialist journals seldom use common names since their scope is often narrow and they are not targeted at a general audience. The *Victorian Naturalist* on the other hand is read by a diverse range of people with just as wide a range of interests and expertise. So common names are desirable for communicating across this broad range. How many of us would know what animal was being referred to in a paper titled "Habitat preferences of *Cherax destructor*"? Yet many of us no doubt caught them by the dozen when we were children and could provide volumes of information on habitat and food preferences of Yabbies.

Agreeing on an appropriate common name is often not an easy task. Some groups have taken the bit between their teeth and thrashed out lists of recommended common names. Australian ornithologists, mammalogists and herpetologists seem to have given the matter a good deal of thought and have produced sensible and comprehensive lists of common names. Botanists also have tackled the problem of standardized common names. Jim Willis gave the issue a great deal of thought when writing "A Handbook to Plants in Victoria". His sources of common names included Ewart's "Flora of Victoria" (1931), CSIRO Bulletin No. 272 ("Standardized Plant Names" 1953) and the Plant Names Subcommittee of the FNCV.

It is perhaps not surprising that some of the less well known plants share common names in Willis since the 1990 edition of "A Census of Vascular Plants of Victoria" by J. H. Ross lists 4,125 taxa (without common names I might add).

It is interesting to note that a list of Rare and Threatened plants currently being prepared by the Victorian Department of Conservation and Environment will include common names for all species. Clearly this is a recognition that these names are meaningful and are readily communicated to land managers and the general public.

Recently we have had a minor debate on whether the first letters of a common name should be upper or lower case. Traditionally capitals have been used to give words emphasis, but the trend in more recent times has been to decrease the use of capital letters. But lower case common names can often lead to confusion. Is a "common blue-tongued lizard" *Tiliqua scincoides* or is it a particularly abundant reptile with a blue tongue and possibly of unknown identity? An upper case initial avoids this problem, particularly when the first word is an adjective. However, this usage suggests that there is some degree of agreement over the nomenclature. This may not be the case with a vernacular name. For this reason we shall only be capitalising the initials of common names which have been carefully considered and allocated by experts in the appropriate field.

Editors spend much time discussing style and standardization and are sometimes criticized for being pedantic. When the business is information communication we must all try to speak the same language. Careful attention to nomenclature, reference citations, punctuation, abbreviation and other points of style helps to communicate the intended message to the greatest number of people. Isn't that why we write? Eds

NOTICE

Calendar of Events will be published in the next issue pending confirmation of speakers.

Impact of an autumn fire on a long-grazed *Themeda triandra* (Kangaroo Grass) grassland: implications for management of invaded, remnant vegetations

Ian D. Lunt*

Abstract

The regeneration of vegetation after an intense autumn fire was studied in a long-unburnt and long-grazed *Themeda triandra* Forssk. grassland at the Derrimut Grassland Reserve, Melbourne. Floristic composition and species richness did not change due to burning. The fire promoted abundant regeneration of exotics from seed, particularly **Vulpia bromoides*, **Romulea rosea*, **Briza minor* and **Aira cupaniana*. However, few native species regenerated from seed. Seedling regeneration reflected the composition of the soil seed bank after 80 years of grazing. In long-grazed grasslands (and presumably other communities) in which exotics are abundant, burning will continue to promote exotic species. If vegetation management aims to promote natives at the expense of exotics, fire cannot be used as the primary tool of management. Integrated techniques of vegetation manipulation must be developed.

Introduction

Temperate grasslands dominated by *Themeda triandra* (Kangaroo Grass: formerly *T. australis*) are poorly represented in conservation reserves in Australia (Specht 1981) and the best remnants in Victoria are typically small fragments on rail and road easements (Stuwe and Parsons 1977, Stuwe 1986). Effective conservation of the grassland biota requires the reservation of large areas, but suitable sites invariably have been grazed by stock for considerable periods. Consequently, they generally have relatively low diversities of native species, few rare plants, many exotics and, at least in some cases, a soil seed bank dominated by exotics (Stuwe and Parsons 1977; Scarlett and Parsons 1982; Stuwe 1986; Lunt 1990a,b).

The maintenance of biological diversity is a principal aim of conservation management. *Themeda* grasslands require frequent disturbance to maintain their diversity, as *T. triandra* may rapidly exclude other herbs due to its tall stature, litter accumulation and lateral tillering (Stuwe and Parsons 1977; Kirkpatrick 1986; McDougall 1989). Many remnants that have not recently been burnt or grazed possess dense *T. triandra* (over 90 percent cover) with few individuals of other species (Stuwe 1986; McDougall 1989).

Burning is generally considered to be the most appropriate form of disturbance (Robertson 1985; Kirkpatrick 1986; Stuwe 1986) as it is less selective than grazing (Robertson 1985) and provides, in contrast to slashing, bare ground for seedling establishment. Mowing or slashing may in fact decrease the diversity of native species (Kirkpatrick 1986). It is usually recommended that *T. triandra* grasslands be burnt every three to five years to maintain diversity (Robertson 1985; Stuwe 1986; McDougall 1987, 1989) although, with little relevant data, the effects of fire frequency, season and intensity, on both native and exotic species, remain largely unresolved.

The Derrimut Grassland Reserve occupies 154 ha, 14 km west of Melbourne, Victoria (37° 48′ 30″ S, 144° 47′ 40″ E), and has been managed for grassland conservation since 1985. It was previously

*Department of Botany, LaTrobe University, Bundoora, 3083. Present address: Flora and Fauna Survey and Management Group, Department of Conservation and Environment, P.O. Box 406, Kew, 3101.

grazed for over 80 years, and during this period was rarely burnt. Some areas were ploughed last century. The vegetation of the reserve is described by Lunt (1990a). The most widespread vegetation is *T. triandra* grassland, the composition of which is similar to that in many grazed, private properties throughout western Victoria (Stuwe 1986). Thus, species richness of native plants is often low (on average, eight natives per 15 m^2); in some places *T. triandra* attains almost 100 percent cover with few other native species; many of the most abundant species are exotic and the soil seed bank is overwhelmingly dominated by exotics (Lunt 1990 a, b). Nevertheless, the reserve is considered to be of National botanical significance (Cheal *et al.* in press) and contains 102 native species including three that are rare or vulnerable in Victoria (Gullan *et al.* 1989) and many others that are rare in the Melbourne region (Cheal *et al.* in press).

In April 1987 part of the reserve was unintentionally burnt. As data on the vegetation and seed bank were collected six months previously (Lunt 1990a, b), this event provided an opportunity to document the effects of a single autumn burn on a long-unburnt and long-grazed *T. triandra* grassland. In this paper, post-fire regeneration is described, and the implications for fire management of long-grazed *T. triandra* grasslands, and invaded remnant vegetations in general, are discussed.

The fire event

About 21 ha of the Derrimut Grassland Reserve were burnt on 18 April 1987. Weather on the day was fine and warm, and little if any rain had fallen in the previous week. The fire front was less than 100 m wide at the northern boundary of the reserve and expanded to about 270 m wide in the south of the reserve. In the calm conditions the fire progressed slowly, giving a uniform, intense burn. All plant material was consumed except for the lower 20-30 mm of tillers of *T. triandra*, which were severely scorched. A thin layer of ash covered the ground after the fire had passed.

Methods

The impact of the fire was studied by three methods: (1) comparing the vegetation in burnt areas with pre-fire data, (2) measuring plant densities in burnt and adjacent unburnt areas, and (3) noting the regeneration strategy and flowering behaviour of all species in the burnt area.

The fire burnt 11, 5 x 3 m quadrats that were surveyed in November 1986. These quadrats were re-sampled in November 1987, as were seven, unburnt (control) quadrats. The cover of all vascular plants in each quadrat was assigned to the Braun-Blanquet scale (Mueller-Dombois and Ellenberg 1974). The pre- and post-fire vegetations of all quadrats were compared by the TAXON computer program – a polythetic, agglomerative, hierarchical cluster analysis – using the Jaccard similarity coefficient in the program SIMQUAL (Rohlf 1985). Presence/absence data were analysed in preference to Braun-Blanquet cover values in order to emphasise floristic over structural changes.

To measure plant densities (individuals per m^2) five transects were placed at 100 m intervals across the eastern and western edges of the burnt area, with their midpoints directly above the fire boundary. Four, 0.25 m^2 quadrats were set 4 m apart on each transect, two in the burnt and two in the unburnt area. A total of 20 quadrats were sampled, 10 burnt and 10 unburnt. All supported species-poor *T. triandra* grassland before the fire. Individuals of all species were counted in each quadrat, as were seedlings and established tussocks of *T. triandra*. Densities were increased by one to calculate the logarithms of null results and were then transformed logarithmically to reduce the heterogeneity of variances and allow statistically valid comparisons by the Student's t-test. Data are presented as backtransformed means with 95 percent confidence limits (Sokal and Rohlf 1981).

The mode of regeneration, from seed or vegetative organs, and the incidence of flowering in 1987 were recorded for all species that regenerated in the burnt area. Plant nomenclature follows Forbes and Ross (1988) and asterisks denote exotic species.

Results

Floristic composition

The comparison of pre- and post-fire data from the eleven burnt quadrats showed no consistent change in vegetation composition as a result of the autumn fire. With only one exception, the post-fire vegetation at each quadrat was more similar to the pre-fire vegetation at that quadrat than to the pre- or post-fire vegetation at any other quadrat. The fire did not affect species richness, and a mean of 24 species per quadrat was recorded both before and after burning. Similarly, the magnitude of vegetation change from 1986 to 1987 was the same in both burnt and unburnt (control) quadrats; the Jaccard similarity index averaged 58 percent for both.

Very few new species consistently appeared in and no species consistently disappeared from quadrats after burning. The annuals **Cuscuta epithymum, *Linaria pelisseriana, Spergularia rubra* and *Wahlenbergia gracilenta* were only recorded from burnt quadrats where they were uncommon or rare, although **C. epithymum* and *W. gracilenta* occurred in other, unburnt parts of the reserve.

Plant densities

Plant densities were measured for 24 species (Table 1). Eight species were significantly more abundant in burnt areas: *Agrostis avenacea, *Aira cupaniana, *Briza minor, Danthonia* species (principally *D. caespitosa* and *D. setacea*), *Juncus bufonius, *Romulea rosea, Themeda triandra* and **Vulpia bromoides. *Bromus hordeaceus* was more abundant in unburnt areas. The annual **Vulpia bromoides* increased 100-fold after the fire, with up to 1150 individuals in one burnt 0.25 m^2 quadrat. The post-fire density of *T. triandra* seedlings was underestimated due to difficulties in distinguishing seedlings from vegetatively regenerating tussocks. Since all tussocks of *T. triandra* regenerated after the fire, the density of established tussocks did not differ significantly between burnt and unburnt quadrats.

Regenerative strategies

Eighty nine species were recorded from the burnt area, comprising 58 natives and 31 exotics (Appendix 1). All annual species and all but three perennials, *Dichondra repens, Pimelea serpylliflora* and *Solenogyne dominii*, flowered by December 1987, within nine months of the fire.

All perennial species proved capable of vegetative replacement, but few multiplied vegetatively: they included *Haloragis heterophylla, Helichrysum rutidolepis* and *Plantago gaudichaudii*. Only ten native and four exotic perennials were observed to regenerate from seedlings: *Acaena echinata, Calocephalus citreus, Convolvulus erubescens, Eryngium ovinum, Helichrysum apiculatum, *Hypochoeris radicata, Leptorhynchos squamatus, Oxalis perennans, *Plantago coronopus, *Plantago lanceolata, *Romulea rosea, Solenogyne dominii, Stipa* species and *Themeda triandra*. However, seedlings of all but **Romulea rosea* and *T. triandra* were considerably less abundant than were plants that regenerated vegetatively. Seedlings of native perennials did not flower in 1987.

Three perennials were more abundant in burnt than unburnt areas: *Themeda triandra, *Romulea rosea* and *Danthonia* species. *Themeda* regenerated from tussocks and seed and **Romulea* from corms and seed, but *Danthonia* species appeared to regenerate from rootstocks of senescent tussocks; there were no seedlings of *Danthonia* species in burnt quadrats or visible tussocks in unburnt quadrats.

One native and one exotic species were recorded from the burnt area that had not

previously been recorded from the reserve, **Linaria pelisseriana* and *Spergularia rubra*. Both were uncommon to rare.

Discussion

Post-fire recovery of this long-grazed *T. triandra* grassland followed the model of initial floristic composition rather than the classical or Clementsian model of relay floristics (Egler 1954), and in this sense it resembled that of most Australian forests (Purdie and Slatyer 1976; Noble and Slatyer 1981). However, in contrast to the abundant regeneration of seedlings that frequently occurs after intense forest fires (Purdie 1977; Ashton 1981; Christensen *et al.* 1981), seedlings of native perennials were very rare. This is clearly demonstrated by a comparison of seedling regeneration with that recorded from dry sclerophyll forest (Purdie and Slatyer 1976) and heath and heathy woodlands (Wark *et al.* 1987).

Table 1. The (back transformed) mean number of individuals per square metre, with 95 percent confidence limits (95% CL), for plant species in burnt and unburnt, species-poor *Themeda* grassland.

"—" no plants recorded. Asterisks denote exotic species and (following means) level of statistical significance:
* = $0.05 > p > 0.01$, ** = $0.01 > p > 0.001$, *** = $p < 0.001$.

	BURNT			UNBURNT		
	95% CL			95% CL		
SPECIES	mean	lower	upper	mean	lower	upper
Acaena echinata	1.3	0.8	2.1	—		
Agrostis avenacea	3.2*	1.3	7.9	—		
**Aira cupaniana*	34***	10	113	—		
**Briza maxima*	7.8	2.0	31.3	4.7	1.3	16.7
**Briza minor*	116***	53	256	—		
**Bromus hordeaceus*	—			4.0*	1.1	15.0
**Cicendia quadrangularis*	1.3	0.7	2.3	—		
Convolvulus erubescens	2.0	1.0	3.9	1.5	0.8	2.6
**Cyperus tenellus*	3.3	0.8	15.0			
Danthonia spp.[1]	2.2*	1.0	4.8	—		
Deyeuxia quadriseta	1.4	0.6	3.3	—		
**Hypochoeris radicata*	3.3	0.3	8.5	2.2	0.9	5.5
Isolepis spp.[2]	1.6	0.8	3.3	—		
Juncus bufonius	7.8*	1.5	41.4	—		
**Juncus capitatus*	1.4	0.7	2.9	—		
**Lolium rigidum*	1.4	0.7	3.0	–		
Oxalis perennans	1.6	0.8	3.1	—		
Plantago gaudichaudii	4.3	1.1	16.6	1.5	0.8	2.6
**Romulea rosea*	606***	461	799	23	10.3	49.5
Schoenus apogon	1.9	0.9	4.3	—		
**Sonchus oleraceus*	1.5	0.8	2.6	—		
Stipa spp.[3]	1.2	0.8	1.7	—		
Themeda triandra (seedlings)[4]	9.5***	0.8	22.8	—		
**Vulpia bromoides*	849***	391	1845	8.0	2.6	24.9

1. *Danthonia* spp. — mostly *D. caespitosa* and *D. setacea*
2. *Isolepis* spp. — mostly *I. hookeriana* and *I. marginata*
3. *Stipa* spp. — mostly *S. bigeniculata*
4. Densities of seedlings of *T. triandra* were underestimated (see text)

While six percent of native perennials from dry sclerophyll forest and 27 percent of those from heath and heathy woodlands were obligate seed regenerators, no grassland perennials employed this strategy. Further, only 19 percent of native perennials in the grassland were observed to regenerate from seed compared with over 60 percent of native perennials in forest, heath and heathy woodland environments.

A previous study at Derrimut found that the soil seed bank was dominated by exotic species, and contained few individuals of few native species (Lunt 1990b). The seed bank of native species was assumed to have been depleted during 80 years of stock grazing, due to continual predation on flowers, seedlings and established plants. The post-fire plant densities recorded in this study correspond broadly with seed densities in the soil, although spatial variability prevents a detailed comparison. Except for *Acaena echinata, Agrostis avenacea, Spergularia rubra* and a *Stipa* species, all natives that regenerated after fire from seed were recorded previously from the seed bank. **Vulpia bromoides* and **Romulea rosea* were the most abundant species in the seed bank and post-fire regeneration, with an average of 3199 viable seeds and 849 plants per m^2 of **V. bromoides*, and 1483 viable seeds and 606 plants per m^2 of **R. rosea* in species-poor *Themeda* grassland (Lunt 1990b).

The paucity of seedling regeneration by native species after this autumn fire probably reflects pre-fire land use (grazing) rather than the regenerative potentials of grassland species. The recent removal of stock grazing may perhaps permit consolidation of the native seed bank and enhanced seedling regeneration (of remaining species) after future fires.

Implications for management

The post-fire abundance of exotic species presents a critical problem for conservation management of long-grazed *T. triandra* grasslands, as any benefit bestowed by burning to the diversity of native species is offset by the dramatic promotion of exotics. In this instance, four species of exotics accounted for 97 percent of individuals after fire: **Vulpia bromoides, *Romulea rosea, *Briza minor* and **Aira cupaniana*. The imposition of a three to five year burning regime, which is widely recommended to maintain the diversity of native species in *T. triandra* grasslands (e.g. Robertson 1985, Stuwe 1986, McDougall 1987, 1989), will undoubtedly maintain high densities of these exotics. Further, despite considerable debate on the impact on exotics of spring and autumn burning (see Robertson 1985, Stuwe 1986, McDougall 1987), any such differences appear minor in long-grazed grasslands. Robertson (1985) found that the post-fire densities of exotic annuals were similar after both spring and autumn burning at Gellibrand Hill. Propagules of exotic species are so abundant at Derrimut that differences in post-fire densities are perhaps inconsequential.

It is worthy of note however that fire did not promote all exotic annual grasses: **Bromus hordeaceus* decreased after burning at Derrimut, as occurred at Laverton North (McDougall 1989).

Given this gross promotion of exotics by fire, it could be argued that too great an emphasis is presently placed on burning as the primary tool of vegetation management. If an aim of management is to promote natives at the expense of exotics, then more intricate techniques of vegetation manipulation will have to be devised. The pertinent question for management of any invaded ecosystem then becomes not, "which of spring or autumn burning promotes the least exotics?", but rather, "which combination of manipulative techniques promotes less exotics than either?"

Degraded, invaded and isolated vegetation remnants should not be managed solely by burning; burning should be integrated with other methods of vegetation control, such as weeding, poisoning and perhaps manipulated, seasonal grazing by native or introduced herbivores. The

role of fire in the management of invaded ecosystems may eventually prove similar to that in agricultural systems, where "fire plays its greatest part in weed control by improving the efficiency of other control methods" (Johnson and Purdie 1981).

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Appendix 1. Post-fire regenerative strategies and the incidence of flowering in 1987 for all species recorded from the area burnt in April 1987.

* = exotic species
V = vegetative regrowth
S = seedling regeneration
Vs = vegetative regrowth with minor seedling regeneration
? = regenerative strategy uncertain
F = flowered during spring-summer 1987

Perennials

Acaena echinata	VFs
Amphibromus nervosus	VF
Asperula conferta	VF
Bothriochloa macra	VF
Brachyscome heterodonta	VF
Calocephalus citreus	VFs
Calotis anthemoides	VF
Carex inversa	VF
Chloris truncata	VF
Comesperma polygaloides	VF
Convolvulus erubescens	VFs
Craspedia chrysantha	VF
Danthonia auriculata	VF
Danthonia caespitosa	VF
Danthonia duttoniana	VF
Danthonia setacea	VF
Desmodium varians	VF
Deyeuxia quadriseta	VF
Dianella revoluta	VF
Dichelachne crinita	VF
Dichondra repens	V
Elymus scabrus	VF
Eryngium ovinum	VFs
Eryngium vesiculosum	VF
Haloragis heterophylla	VF
Helichrysum apiculatum	VFs
Helichrysum rutidolepis	VF
**Holcus lanatus*	?F
Hypericum gramineum	VF
**Hypochoeris radicata*	VFs
Juncus subsecundus	VF
**Leontodon taraxacoides*	VF
Leptorhynchos squamatus	VFs
Minuria leptophylla	VF
Myriophyllum sp.	VF
Oxalis perennans	VFs
Pimelea curviflora	VF
Pimelea serpyllifolia	V
**Plantago coronopus*	VFs
Plantago gaudichaudii	VF
**Plantago lanceolata*	VF ?s
Poa sieberiana	VF
Podolepis jaceoides	VF
Ptilotus macrocephalus	VF
Ptilotus spathulatus	VF
**Romulea rosea*	VFs
Rumex dumosus	VF
**Salvia verbenaca*	VF
Schoenus apogon	VF
Solenogyne dominii	VS
Stackhousia monogyna	VF
Stipa bigeniculata	VF
**Stipa neesiana*	VF
Stipa rudis	VF
Stipa setacea	VF
Themeda triandra	VFs
**Tribolium acutiflorum*	?F
Tricoryne elatior	VF
Velleia paradoxa	VF
Vittadinia cuneata	VF
Wurmbea dioica	?F

Annuals

All species regenerated from seed and flowered in 1987

Agrostis avenacea
**Aira cupaniana*
**Arctotheca calendula*
**Briza maxima*
**Briza minor*
**Bromus hordeaceus*
**Centaurium tenuiflorum*
**Cicendia filiformis*
**Cicendia quadrangularis*
**Cuscuta epithymum*
**Cyperus tenellus*
Isolepis marginata
Juncus bufonius
**Juncus capitatus*
**Linaria pelisseriana*
**Lolium rigidum*
**Parentucellia latifolia*
Sebaea ovata
**Sonchus oleraceus*
Spergularia rubra
**Trifolium angustifolium*
**Trifolium campestre*
**Trifolium dubium*
**Trifolium glomeratum*
**Trifolium striatum*
**Vulpia bromoides*
**Vulpia myuros* forma *megalura*
Wahlenbergia gracilenta

Mammals of The Gurdies, Westernport Bay, a proposed Flora and Fauna Reserve

C. G. Wilson*

Abstract

The MSGiV recorded a total of 17 native and 2 introduced species of mammal in 5 surveys of The Gurdies between 1972 and 1987. A general description of the study area is presented, and the significance of the survey results are discussed.

Introduction

The Mammal Survey Group of Victoria Inc. (MSGV) is a voluntary organization with a main purpose of conducting surveys of the native land mammals of the State. The Gurdies, on the eastern shore of Westernport Bay, is in the Land Conservation Council (LCC) Melbourne Study Region (District 2). A list of mammals for the region, including early records of the MSGiV, was published in 1973 (LCC 1973). More recently a locality list of mammals for the Westernport Region using a 5 minute latitude by 5 minute longitude grid system was published (Andrew *et al.* 1984), although no additional surveys were undertaken in The Gurdies. The Gurdies area was recommended as a Flora and Fauna Reserve by the LCC 13 years ago (LCC 1977) and recognized by Andrew *et al.* (1984) as a site of zoological significance. Its current legal status is Unreserved Crown Land, however management is being undertaken by the Department of Conservation and Environment in anticipation of full legal status. This paper summarizes the species of mammals recorded by the MSGiV in The Gurdies between 1972 and 1987.

Description of the Study Area

Located on the Bass Highway approximately 12 km south-east of the intersection with the South Gippsland Highway, the survey area (Fig. 1) is representative of some of the largest remaining areas of native vegetation on the eastern shore of Westernport Bay. Having rural residential boundaries, The Gurdies (206 ha) includes vacant Crown land which is timbered and scrub covered, apart from two gravel pits, the northern one being still in use.

Vegetation consists of open forest, the general canopy level being at a height of 10-15 m, and comprising mainly Messmate (*Eucalyptus obliqua*), and Narrow-leaved Peppermint (*E. radiata*). The understorey is sparse with a variety of wattles, chiefly Blackwood (*Acacia melanoxylon*), and eucalypt saplings to a maximum height of about 10 m. Shrub vegetation includes Variable Sallow Wattle (*Acacia mucronata*), Hop Wattle (*A. stricta*), Prickly Moses (*A. verticilata*), Silver Banksia (*Banksia marginata*), Showy Bossiaea (*Bossiaea cinerea*), Sweet Bursaria (*Bursaria spinosa*), Dogwood (*Cassinia aculeata*), Black She-oak (*Casuarina littoralis*), Scrub She-oak (*C. paludosa*), Prickly Tea-tree (*Leptospermum juniperinum*), Heath Tea-tree (*L. myrsinoides*), Spike Beard-heath (*Leucopogon australis*), Snowy Daisy-bush (*Olearia lirata*), and Prickly Geebung (*Persoonia juniperina*). Except for some dense heathy patches of vegetation, the shrub layer is generally sparse and ranges from about 2-4 m in height. Density of ground cover varies considerably throughout the study site and includes Austral Bracken (*Pteridium esculentum*), various sedges, grasses and leaf litter. Several fern species are associated with wetter areas such as the creek environment.

Observations by the MSGV suggest that the area has occasionally been used as a source of firewood and fence posts. The

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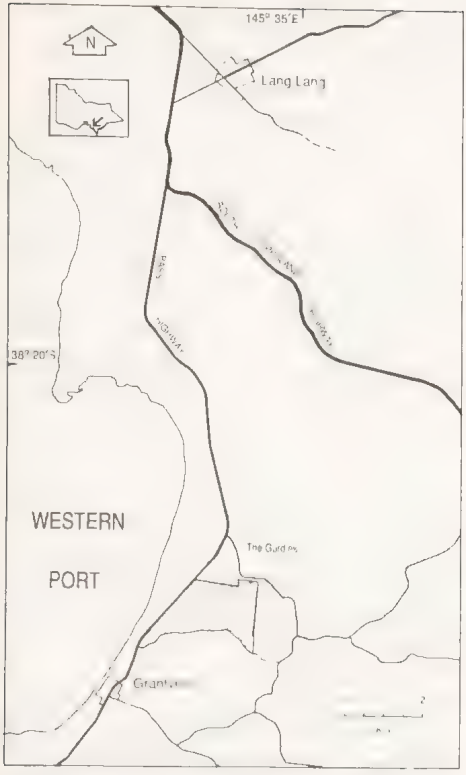

Fig. 1. Location map of The Gurdies indicating the study site surveyed (shown stippled). Map reference (AMG) 8021 – 749495.

land scouring effects of mining, regular motorcycle and horseriding activities are also evident; during the last visit to the study area (1987), both of the latter recreational activities were witnessed.

Methods

Data was collected by surveys and chance encounters over the periods, 29-31 January 1972, 11-12 September 1982, 28-30 January 1984, 15-16 September 1984, and 9-10 May 1987.

Surveys consisted of trapping, spotlighting on foot, and the observation of any incidental evidence. At each survey period the number of personnel and hence the number of traps set and hours spent spotlighting varied.

Wire cage traps (36 x 20 x 15 cm), baited with a mixture of rolled oats, peanut butter and honey, wrapped in medical gauze, were set each afternoon by 1700 h and collected the following morning by about 0800 h. Captured animals were released in the precise locality where they were caught.

Spotlighting was undertaken after dusk using 12 v sealed beam spotlights and batteries. The number of spotlights carried in each party was no greater than two.

Bat trapping was undertaken at every camp except the first (1972). These mammals were surveyed using two collapsible bat traps (Tidemann and Woodside 1978) placed in potential bat flyways.

Chance encounters included daylight records of specimens seen alive, those killed on the roads within one kilometre of the study site, and scats and diggings.

The identification of all live specimens relied upon the experience of the observers. No rare species (for the area) was recorded unless identified by at least two observers or by someone familiar with the species, and no data were recorded unless identification was beyond reasonable doubt. Scientific and common names used for mammals follow Walton (1988), except for *Eptesicus darlingtoni* (Kitchener *et al.* 1987).

Results

Small Mammal Trapping

A total of 91 individuals of 5 species were trapped in 737 trap-nights, giving an average trapping rate of 12.3% (Table 1). Brown Antechinus (*Antechinus stuartii*) and Bush Rat (*Rattus fuscipes*) were trapped in all periods while only one specimen each of Swamp Antechinus (*Antechinus minimus*) and Southern Brown Bandicoot (*Isoodon obesulus*) was trapped, both in summer.

Spotlighting

A total of 214 individuals of 8 species were seen in a total of 56.5 spot-hours, giving an average spotlighting rate of 3.8

Table 1. Small mammal trapping results for The Gurdies (1972-1987).

		Survey Period					
		Jan 1972	Sep 1982	Jan 1984	Sep 1984	May 1987	Total Individuals Trapped
Species trapped:							
Antechinus stuartii	(Brown Antechinus)	6	4	8	6	13	37
Antechinus minimus	(Swamp Antechinus)			1			1
Isoodon obesulus	(Southern Brown Bandicoot)	1					1
Rattus fuscipes	(Bush Rat)	11	8	13	11	4	47
Rattus lutreolus	(Swamp Rat)			1		4	5
Number of individuals:		18	12	23	17	21	91
Number of trap-nights:		161	115	246	96	119	737
Trapping rate (%):		11.2	10.4	9.3	17.7	17.6	12.3

animals/spot-hour (Table 2). Common Ringtail Possum (*Pseudocheirus peregrinus*) comprised 90.6% of animals seen and Eastern Grey Kangaroo (*Macropus giganteus*) 4.2%.

Bat Trapping

A total of 30 individuals of 4 species of bat were trapped in 9 trap-nights (Table 3). Little Forest Eptesicus (*Eptesicus vulturnus*) comprised 63% of bats caught and 73% of bats were trapped in summer.

Daylight sightings and incidental evidence

Evidence for an additional 3 species of mammal was collected (Table 4). European Rabbits (*Oryctolagus cunniculus*) were seen, a dead Common Brushtail Possum (*Trichosurus vulpecula*) was observed on a road, and diggings and scats of Common Wombat (*Vombatus ursinus*) were recorded.

Discussion

A total of 17 native species of mammal, including one species of monotreme and 4 species of bat, and 2 introduced species of mammal were recorded in the survey of The Gurdies. This represents 47% of the native mammal fauna (excluding marine mammals) found in the whole

Table 2. Spotlighting results for The Gurdies (1972-1987).

		Survey Period					
		Jan 1972	Sep 1982	Jan 1984	Sep 1984	May 1987	Total individuals recorded
Species recorded:							
Tachyglossus aculeatus	(Short-beaked Echidna)	1					1
Isoodon obesulus	(Southern Brown Bandicoot)	1					1
Petaurus breviceps	(Sugar Glider)		1	1			2
Pseudocheirus peregrinus	(Common Ringtail Possum)	13	42	58	37	44	194
Macropus giganteus	(Eastern Grey Kangaroo)	2	3	1	2	1	9
Wallabia bicolor	(Swamp Wallaby)	1	1	2	1		5
Phascolarctos cinereus	(Koala)	1					1
Vulpes vulpes	(Fox)			1			1
Number of individuals:		19	47	63	40	45	214
Spot-hours:		13.5	10	15	7.3	10.7	56.5
Spotting rate (animals/spot-hour):		1.4	4.7	4.2	5.5	4.2	3.8

Table 3. Bat trapping results for The Gurdies (1982-1987).

		Survey Period				
		Sep 1982	Jan 1984	Sep 1984	May 1987	Total Individuals Trapped
Species trapped:						
Chalinolobus gouldii	(Gould's Wattled Bat)		2			2
Eptesicus darlingtoni	(Large Forest Eptesicus)			2		2
Eptesicus vulturnus	(Little Forest Eptesicus)		14	5		19
Nyctophilus geoffroyi	(Lesser Long-eared Bat)		6		1	7
Number of individuals:		0	22	7	1	30
Number of bat trap-nights:		1	4	2	2	9

Westernport Region since 1970. The region comprises a total of 3240 km² which includes the Mornington Peninsula, the eastern edge of Westernport Bay, French Island, Phillip Island, and north to Gembrook and Neerim South (Andrew *et al.* 1984). The records of Swamp Antechinus and the 4 bat species, Little Forest Eptesicus, Large Forest Eptesicus (*Eptesicus darlingtoni*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*; Fig. 2) and Gould's Wattled Bat (*Chalinolobus gouldii*) are new records for the survey area, although they have all been recorded elsewhere in the region (Andrew *et al.* 1984).

Fig. 2. Lesser Long-eared Bat *Nyctophilus geoffroyi*. Photo J. Olden.

Table 4. Daylight sightings and incidental evidence of mammals in The Gurdies (1972-1987).

		Survey Period					
		Jan 1972	Sep 1982	Jan 1984	Sep 1984	May 1987	Total individuals sighted
Species recorded:							
Tachyglossus aculeatus	(Short-beaked Echidna)		1	1			2
Antechinus stuartii	(Brown Antechinus)	1					1
Trichosurus vulpecula	(Common Brushtail Possum)			1			1
Macropus giganteus	(Eastern Grey Kangaroo)	1			14		15
Wallabia bicolor	(Swamp Wallaby)	4		2	1		7
Vulpes vulpes	(Fox)	2		1			3
Oryctolagus cuniculus	(European Rabbit)			1			1
Number of individuals:		8	1	6	15	0	30
Incidental evidence:							
Echidna diggings		x			x	x	
Bandicoot diggings			x	x			
Sugar Glider calls					x		
Wombat diggings and scats			x				
Bat/s spotlit		x	x				
Rabbit scats		x					

x Recorded in survey

The Southern Brown Bandicoot and the Koala (*Phascolarctos cinereus*) were only recorded in 1972, however diggings ascribed to bandicoot spp. were observed in 1982 and 1984. In the context of urban sprawl, Dixon (1966) and Seebeck (1977) have indicated that habitat destruction and predation pressures are factors which will continue to threaten populations of the Southern Brown Bandicoot in the Westernport catchment. The lack of tree species commonly used as food may account for the Koalas low density (for details of Koala habitat and tree preferences, see Lee and Martin 1988).

The record of a Swamp Antechinus (Fig. 3) represents the fourth, and possibly the most recent, record of the species in the Westernport catchment area since 1970. The animal (adult, female) was captured at a trapping site in open forest having a dense heathy shrub layer of Prickly Tea-tree, Heath Tea-tree, Silver Banksia and Scrub She-oak. Ground cover at the trapping site was also dense. The Swamp Antechinus is considered endangered in Victoria because of its restricted (generally) coastal distribution coupled with the associated risk factors as indicated above for the Southern Brown Bandicoot (for details of habitat requirements of the Swamp Antechinus, see Wainer and Gibson 1976). In contrast to the Swamp Antechinus, the Brown Antechinus, another of the insectivorous marsupials, is common and well dispersed throughout the study area. Unlike the Swamp Antechinus, the Brown Antechinus has a comparatively widespread distribution and inhabits widely differing vegetation types in south-eastern and eastern Australia (Wakefield and Warneke 1967; Hampton *et al.* 1982).

The Common Ringtail Possum was the most abundant and widespread species surveyed. Other arboreal species were rarely observed; only one road-killed specimen of the Common Brushtail Possum on the Bass Highway, outside the forested area, and 2 Sugar Gliders (*Petaurus breviceps*) were sighted.

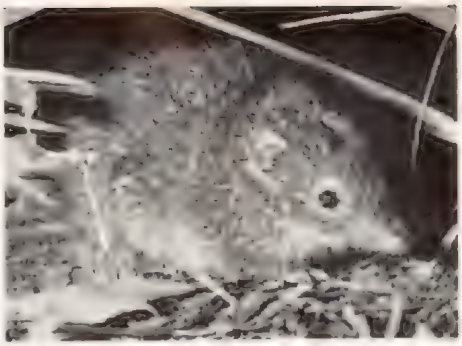

Fig. 3. Swamp Antechinus *Antechinus minimus*. Photo J. Olden.

Of the macropods, 2 species, the Eastern Grey Kangaroo and the Swamp Wallaby (*Wallabia bicolor*) are well represented; within the study area there is cover for refuge and shelter during the day, an important habitat requirement (Caughley 1964; Edwards and Ealey 1975).

The Bush Rat, a native rodent, is commonly dispersed throughout the study area. Less commonly trapped, the native Swamp Rat (*Rattus lutreolus*) has a distribution localised centrally within the forest and only where dense ground cover occurs. The introduced rodents, House Mouse (*Mus musculus*) and Black Rat (*Rattus rattus*) were not captured during the survey, although House Mouse has been recorded in the area and Black Rat nearby (Andrew *et al.* 1984).

Using similar methodology, overall average small mammal trapping and spotlighting success rates for all study areas of Victoria surveyed by the MSGV between 1972 and 1987 are 12.6% and 1.8 animals/spot-hour, respectively (J. Poynton, MSGV Records Officer). A comparison indicates The Gurdies had a similar average small mammal trapping success rate (12.3%), and a higher than average spotlighting success rate (3.8 animals/spot-hour).

The MSGV survey of The Gurdies indicates that the area contains a significant proportion of the native mammal fauna of the Westernport Region. Nevertheless, The Gurdies is small in area and has a current legal status as

Unreserved Crown Land, so its long-term future is not assured. Government enactment of the 13-year old recommendation of the LCC, to create a Flora and Fauna Reserve, should aid its long-term conservation in terms of habitat and species protection. The data presented in this paper would be useful in the planning of an appropriate management strategy for the Flora and Fauna Reserve.

Acknowledgements

Data presented in this paper was collected by members of the MSGV between 1972 and 1987. The author wishes to acknowledge Mr. J. Barnett for comments on the manuscript. Mr. J. Olden kindly provided the two photographs. Protected species of mammals were handled under the provisions of permits issued by the Fisheries and Wildlife Division of the Department of Conservation, Forests and Lands. Equipment used in the survey and part maintenance costs were provided by grants from the M.A. Ingram Trust.

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The pond hunters dream

D. E. McInnes

The pond hunter is that odd person who may be seen occasionally, dipping with his pond net into a lake or pond and transferring the contents into jars which he then takes home. Here he eagerly pours the water into shallow dishes, places them under the microscope and looking through the microscope hopes that he will see some of those wonderful pond creatures that are so well illustrated in the books on pond life.

Every pond collection always has some form of pond life to be seen, you never come home empty handed. Sometimes only a few things other times quite a few and that great occasion when you see something you have never seen before.

Pond hunters in their rambles always have that dream of the pond that has all the interesting forms of life they read about but never come across in their samples of pond life.

Well last November I came across the Dream Pond close to home, it was the lake in the lovely Hedgely Dene Gardens in East Malvern.

My equipment to take a sample could not be simpler. It consisted of two plastic ("Muesli") bags, one inside the other to make sure they don't leak, a couple of thick rubber bands (I pick up the ones the postman throws onto the footpath) and an old bootmaker's knife to cut roots.

At the lake I go to the spot where an old Willow tree grows near the bank. Here the willow roots can be seen growing out from the bank under the water level, the roots make an ideal place for all sorts of pond life that live attached.

First I fill up the plastic bag with pond water and place it upright so it does not spill (not so easy), the water is a bright green colour, full of microscopic plants, to the creatures living in the pond it is like living in a world of vegetable soup. All you have to do is open your mouth and swallow. What a life of luxury.

Next job is to cut with the boot makers knife the end pieces of willow root about 25 cm in length, cut some from different places and fill up the plastic bag, secure the top of the bag with the rubber bands. When home, empty the bag into a shallow container, a 4 litre icecream container is ideal.

To view the pond life I use large and small petri dishes, these can be made by cutting rings of plastic downipipe that is 45 mm and 90 mm in diameter, the rings being 10 mm and 20 mm wide. Stick the rings to squares of glass (2.0 mm thick or less) with Selleyes window and glass cement. A hint, clean the glass with detergent then polish with 'Bon Ami'.

The method to examine the material is to first look at the attached forms then look at the free swimming forms, so cut several pieces of the roots about 6 cm long and place them in a large petri dish with water covering them. (do not have parts sticking out of the water) and examine under a low power stereo microscope or under the lowest power of the ordinary microscope (15 X or 20 X). Look at all the pieces of weed or root. Use top lighting and dark ground lighting, I use both together.

When you see an interesting part that needs higher power, cut off a small section 20-30 mm long and transfer to a small petri dish with just enough water to cover the root, examine with 100 X after checking the object is in the field with the lower power. Use darkground lighting to show up the colour then bright field lighting to see most detail.

Now to see the free swimmers. Beside the animal free swimmers most of the algae are active swimmers as well and like human beings they all like to be in the

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Compiled by K.N. Bell

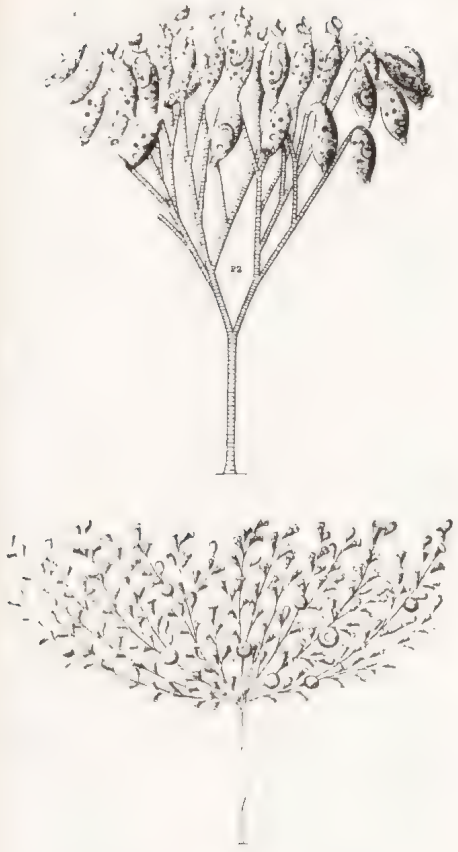

Fig.1. *Opercularia* (top) and *Zoothamnium* (bottom). Reprod. from Kent (1882).

limelight. Taking a good sample of the pond water in the large dish place it under the stereo or low power microscope and it will be noticed that all will tend to swim to the centre bright field. Take a pipette and suck up the concentrated sample and transfer it to a small petri dish. Examine the sample with 100 X, first with dark ground lighting then with the bright field.

After those hints on methods let us look at some of the willow roots. Even with the naked eye many of the roots seem to be covered with fine hairs but under the microscope the growth is seen to be a mass of fine branching stems, at the end of each stem is a "head" like half of a cigar with a partly opened "lid" at the wide end. The "lid" has a ring of cilia beating furiously and causing a current of water to bring particles of food to the mouth below the "lid". This is indeed an animal, one of the single celled animals, the only movement is a quick bending of the "head" when disturbed.

The "lid" is similar to the operculum of the periwinkle and the name *Opercularia* Fig. 1 is given to the genus. A point of interest, after a short period all the "heads" will leave the stems and swim away, and just a mass of stems is left behind.

On other roots more groups are seen but this time there is only a single stem to each "head" which is bell shaped with the ring of cilia around the bell mouth. Of course they were called "Bell Animalcules", now the genus is *Vorticella*. At the slightest touch the stem will contract like a spiral spring, there is a muscular strand down the centre of the stem that causes the retraction, then slowly the stem stretches out again and the cilia again start their beating.

Here and there among the roots there is what seems to be a large bunch of *Vorticella* on a single stem rather like a bunch of flowers, then all of a sudden the whole bunch shrinks to a tiny ball and the stem also contracts. What is it? It is called *Zoothamnium* Fig. 1 (Animal Bush). The "heads" are similar to the *Vorticella* and have the muscle strand in the stems but it also continues down the main stem so all the "heads" are drawn into a ball and the main stem into a short spiral.

Along the root there is a trumpet shape attached to the root by the narrow end and at the wide end the edge is lined with cilia. Yes you have guessed right, it is the "Trumpet Animalcule" or *Stentor Polymorphus* Fig. 2 (many forms) because sometimes it may build a gelatinous tube around itself and at other times may be seen somewhat shortened actively swimming around. In most cases the cilia ring will propel its owner through the water unless attached to something.

Fig.2. *Stentor.* Reprod. from Kent (1882).

Looking around we find many little brown tubes attached to the roots and out of the tubes pops a little head. Checking under the higher power the head appears to be two little wheels and careful examination shows here we have one of the "Wheel Animalcules" or *Rotifers*. These creatures are the favourites of the pond life hunters with their variety of shapes and ways of living. They all have a ring or corona of cilia which may be irregular or with one ring, two ring, four ring and in one case without cilia. One other common feature is the jaws or "mastax", these are rather strange. Hold your fists closed and together at the wrists. Open and close your clenched fists at the wrists, this gives the crushing appearance of one type of mastax. Now open your fingers half way and open and close your hands at the wrist and this shows how the mastax is used for grasping and chewing. The tube of this rotifer is made of rings (faintly) and is untidy, sometimes there are other tubes growing from the side. The corona has two lobes like a figure eight, the long body inside the tube is attached to the root. The name of this rotifer is *Limnias* Fig. 3.

Careful hunting finds another brown tube but a neater one this time, a closer look shows we have a prize, a rotifer called the "Little Brickmaker", its name is *Floscularia* Fig. 3 (in the old books it was *Melicerta*). The corona has four lobes two larger than the others, the rotifer is very touchy and retreats into the tube at the slightest movement, the cilia causes particles to run right around the corona and into the mouth to be mashed up by the jaws of the mastax. The rotifer spearates the unedible particles, mixes them up into a tight ball and deposits the balls like bricks in neat lines to form the wall of its tube.

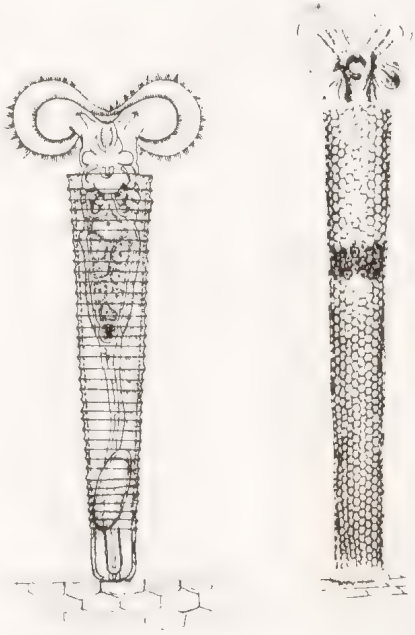

Fig.3. *Limnias* (left) Reprod. from Ward and Whipple (1963) and *Floscularia* (right) Reprod. from Carpenter (1901).

Fig.4. *Collotheca.* Reprod. from Carpenter (1901).

The next Rotifer is quite different, it is set in a clear gelatinous tube attached to the root, as it emerges from the tube five lobes start to expand but instead of cilia many very fine rays extend out until they are in straight lines in all directions from the lobes. Small protozoans and motile algae coming in contact with the rays move toward the centre and the mouth where they are gulped down and passed to the mastax to be chewed up.

There are two varieties, one has broad lobes but the other has long narrow lobes. The rotifer is named *Collotheca* Fig. 4 (to add to the confusion it used to be *Floscularia*) and is quite colourful when seen with darkground lighting, one or two oval eggs may be seen alongside the body inside the gelatinous tube. *Collotheca* is a prize exhibit when shown at a Microscopical Meeting on rare occasions, but here there were hundreds, on one root 5 cm long I counted 42 and actually had 12 in the field of the microscope at one time. What a pond hunters dream.

Quite easy to see and very different were Hydras which have six tentacles that are lined with stinging cells similar to jellyfish to which they are related. Any little water flea bumping the tentacles is stung and the tentacles push the flea to the mouth in the centre, the mouth opens wide to swallow the meal. At the side of the Hydra a bud develops into a new hydra complete with its own tentacles.

Growing along a stem is a nearly transparent tube, at regular intervals there are protrusions like a narrow volcano. When all is still, out from the volcanoes comes a mass of tentacles, these spread out and it is seen that they are attached to a "U" shaped base, the tentacles are lined with cilia which beat in unison to cause a river of water to flow through the forest of tentacles.

Any suitable food particles are guided to the mouth in the centre of the "U" base, particles not suitable for food are let through the tentacles and if large objects arrive one or more of the tentacles will bend out of the way and let them flow away. This spectacular creature is quite a find and it is one of the fresh-water bryozoa and the name is *Plumatella* Fig. 5. The food is passed to the stomach through a short intestine and out through an opening at the back of the base of the "U".

At the bottom of the intestine a fine tube branches off and here develops an oval egg which grows a central oval of dark brown with a lighter brown oval around it. The eggs are statoblasts and develop for Winter and Summer.

Looking along some roots with a higher power there is a finger shaped form with a narrow stem joining it to the root, all around the top of the finger are rays pointing out in every direction and at the lower end of the finger there are two bunches of rays. Each ray has a tiny knob at the end of it. In fact it all looks like a fancy pin cushion. There is no movement. How does it live? Well any small single celled

Fig.5. *Plumatella* (top) Reprod. from Ward and Whipple (1918) and *Podophrya* (bottom) Reprod. from Hollowday (1946).

creature coming in contact with the "pinheads" becomes stuck and the "pinhead" penetrates the wall of the victim and then like a vampire all the internal juices are sucked out along the rays. The animal is one of the Suctoria a sub class of the Ciliates, this specimen has no hard lorica and is named *Podophrya* Fig. 5 (old book) a smaller specimen with a hard lorica and two bunches of rays was from the genus *Acineta*.

So far all the interesting creatures seen have been attached to the roots so if we had just dipped in the pond net for samples we would have missed the prize exhibits just described, so now let us look at the free swimmers.

Quickly swimming across the field under the mircoscope are a variety of shapes, all attracted to the field of light. Most obvious is one like a large clear plastic bag with a ring of cilia driving it around, inside can be seen all the internal organs including the jaws (mastax) of a rotifer, so it is the rotifer *Asplanchna* Fig. 6 which is quite carnivorous and will swallow other small rotifers or water fleas. Sometimes a young *Asplanchna* can be seen developing inside the rotifer until it is nearly half the size of the mother then it is expelled and both go on their way.

Some of the rotifers have a hard shell or lorica and one we see is round in shape with various spines at the front and back ends, the ciliary ring brings food and allows the rotifer to swim about. From the rear end extends a foot like an elephants trunk, lined and pliable with a couple of toes at the end to hold on. Sometimes this rotifer *Brachionus* Fig. 7 can be seen swimming but anchored by a thread extruded from the toes and attached to a surface. Very often one or two eggs will be seen attached to the base of the foot, as these are hatched externally.

Another form is a blunt ended cigar with the cilia ring at the blunt end which has a few sharp spikes and extending back are three spines more than twice as long as the body. This is *Filinia* Fig. 7 (used to be *Triarthra*) and while swimming around slowly the spines will jerk down suddenly and move the rotifer away from any trouble.

Fig.6. *Asplanchna.* Reprod from Hollowday (1946).

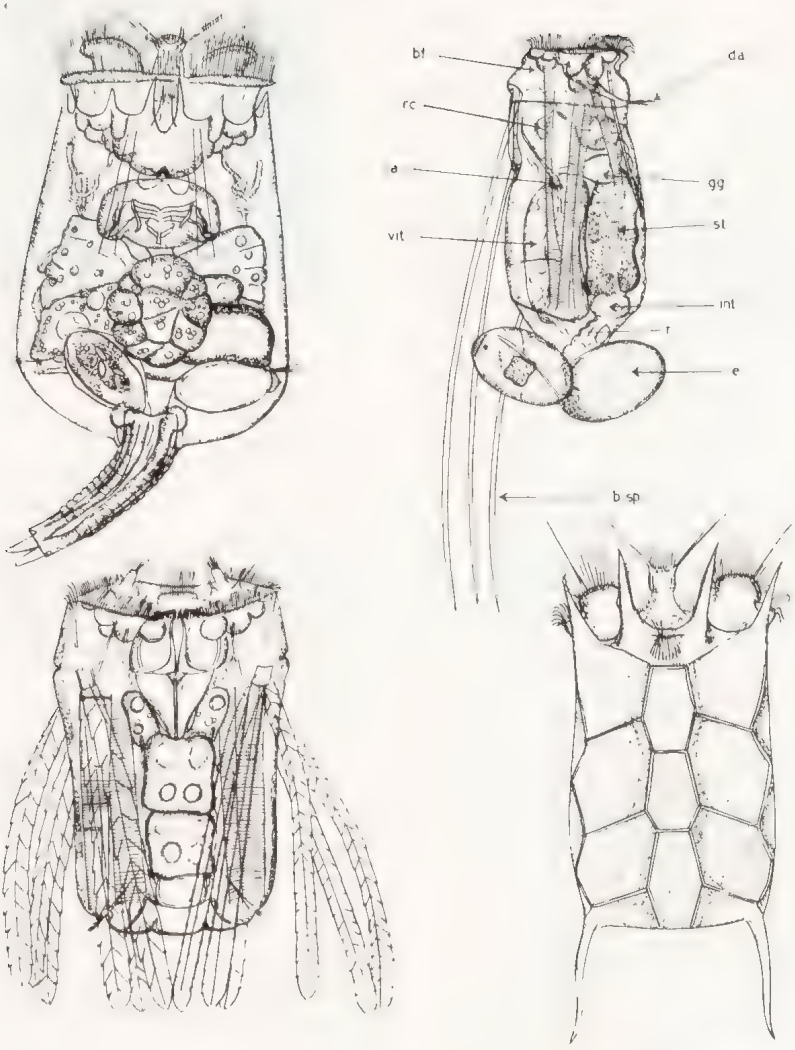

Fig.7. *Brachionus* (top left), *Filinia* (top right) *Polyartha* (bottom left). Reprod. from Hollowday (1946a) and *Keratella* (bottom right) Reprod. from Hollowday (1946b).

Now you see it and now you don't is the feature that identifies another tiny rotifer like a wide oblong in shape with a number of short paddle like spines, the name is *Polyarthra* Fig. 7 (many joints). It will be seen slowly swimming along by means of the cilia ring then it disappears and you will find it in another part of the field. The paddle like spines jerk the rotifer away so quickly that the eye cannot follow it.

One more small rotifer seen was *Keratella* Fig. 7 with a lorica of many plates. The front end has a number of curved sharp spines but at the rear there is a large pair of "cow horns" sometimes a large and a small "cow horn" and at other times just one "cow horn".

Always crowding into the field of the microscope were very tiny reddish spheres propelled along by a long flagellum, they have a red "eye spot" and always seek to be in the light where they remain stationary. Gradually the whole field is filled up with them, if you shifted the petri dish to a clear part they would again move and fill up the field. They are one of the algae called *Trachelomonas* which is related to the *Euglena,* a torpedo shaped green algae also with a red "eye spot" and flagellum. The *Euglena* can change its shape to a sphere or back to a torpedo and often does so, it is also a light seeker and swims rapidly.

The most prominent algae in the green water of the pond was *Dictyosphaerium* (net sphere), minute green balls consisting of even smaller spheres in groups of four borne on stalks. Here and there were bright Desmids, one like a crescent moon *Closterium*, another in the shape of a cross *Staurastrum*.

Like a green dust in the water and needing magnification of 400 to identify were the algae *Scenedesmus, Ankistrodesmus* and *Selenastrum* with an odd *Pediastrum*. Now and again a graceful square raft of sixteen green cells of *Gonium* would swim by, propelled by their delicate but vigorous flagella.

Last but certainly not least in interest was a small translucent sphere like a dense mass of bubbles, the outer layer a little less dense than an inner circle. Fine rays extend out from all parts of the sphere, the rays are pliable and are covered with protoplasm that streams up and down to the body. This is *Actinosphaerium* Fig. 8 one of the Heliozoa. A small protozoan touching the rays becomes caught and is carried down with the layer of protoplasm to the body which engulfs the protozoan. Even a large organism can be caught and the body will rise up towards and absorb it, similar to the action of an amoeba. The *Actinosphaerium* is like an amoeba with rays. It makes a splendid exhibit under the microscope.

Fig.8. *Actinosphaerium.* Reprod. from Carpenter (1901).

Other odds and ends could be mentioned but this is enough to show that this pond was indeed the 'pond hunters dream'. Back in 1856 P.H. Gosse in his book "Tenby" wrote wonderful descriptions of living creatures seen under the microscope and today they are still to be seen if you look below the surface of that ordinary looking old pond or lake in your own park.

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FIELD NATURALISTS CLUB OF VICTORIA
Report by Council

The members of the Council submit herewith the Balance Sheet as at 31 December 1989, and the Statement of Income and Expenditure for the year ended on that date, and report as follows:

1. The names of the members of the Executive Council in office at the date of this report are as follows:

   Mr. G. Love
   Mr. J. Grusovin
   Mr. B. Abbott
   Dr. J. Douglas
   Mrs. S. Houghton
   Miss M. Allender
   Miss R. Watson
   Mr. M. McBain
   Mr. T. Offor
   Mr. N. Mcfarlane
   Dr. A. Parkin
   Mr. G. Gillespie

2. The principal activities and objects of the Club are to stimulate interest in natural history and to preserve and protect Australian fauna and flora. No significant change in the nature of those activities occurred during that period.
3. The net deficit of the Club for the year ended 31 December 1989 was $9,681.00 (1988 surplus $697.00) in the General Account. In addition, surpluses were earned in the following Funds:

   Building Fund
   Excursion Fund
   Publications Fund
   Special Funds

4. The Club is prohibited from paying a dividend by its Memorandum and Articles of Association; consequently no dividend is recommended and no dividends have been paid.
5. The review of operations for the year:
   The Club's groups met regularly throughout the year. The Botany, Day, Geology and Mammal Survey Groups arranged day trips and extended excursions. The Australian Natural History Medallion was administered and awarded to Mr. Bruce Fuhrer.
6. No significant changes in the state of affairs of the Club occurred during the financial year ended 31 December 1989.
7. No matters or circumstances have arisen since the end of the financial year which significantly affected or may significantly affect the operations of the Club, the results of those operations, or the state of affairs of the Club in financial years subsequent to the financial year ended 31 December 1989.
8. The likely developments in the operations of the Club and the expected results of those operations in financial years subsequent to the financial year ended 31 December 1989 are unlikely to have any significant effect on the financial results in future years.
9. Information of Members of the Council:
   Graeme Love - President
   Occupation - Public Servant
   Council Member since 1985
   Julian Grusovin - Secretary
   Occupation - Laboratory Technician
   Council Member since 1987
   Bruce Abbott - Treasurer
   Occupation - Public Servant
   Council Member since 1989
   Jack Douglas - Member of Council
   Occupation - Geologist
   Council Member since 1986
   Sheila Houghton - Member of Council
   Occupation - Retired
   Council Member since 1981
   Marie Allender - Member of Council
   Occupation - Retired
   Council Member since 1956
   Robyn Watson - Member of Council
   Occupation - Botanist
   Council Member since 1989
   Michael McBain - Member of Council
   Occupation - Company Director
   Council Member since 1987
   Tim Offor - Member of Council
   Occupation - Botanist
   Council Member since 1989
   Neil Mcfarlane - Member of Council
   Occupation - Consultant
   Council Member since 1989
   Alan Parkin - Member of Council
   Occupation - University Lecturer
   Council Member since 1989
   Graeme Gillespie - Member of Council
   Occupation - Zoologist
   Council Member since 1989
10. Since the end of the previous financial year no member of the Council has received or become entitled to receive any benefit by reason of a contract made by the Club with him or with a firm of which he is a member or with a company in which he has substantial financial interest.

SIGNED at MELBOURNE this 30th day of April 1990 in accordance with a resolution of the Council.

G. Love, President
B. Abbott, Treasurer

FIELD NATURALISTS CLUB OF VICTORIA
STATEMENT OF INCOME & EXPENDITURE – YEAR ENDED 31 DECEMBER 1989

INCOME

	1989 $	1988 $
Subscriptions Received		
Arrears		—
Current	15,915	16,140
Supporting	136	559
	16,051	16,699
Sales of "Victorian Naturalist"	290	383
Advertisements	—	—
	290	383
Interest Received		
Library Fund	15	15
Bank Account	314	161
Commonwealth Bonds	1,475	1,475
Bonds – M Wright Legacy	767	767
Bonds – C M Walker Legacy	147	147
Deposit	—	—
Life Membership Fund	109	40
Natural History Medallion Fund	—	—
	2,827	2,605
Sundry Income	662	1,459
Profit on Book Sales	758	1,022
Microscope	—	50
Profit on Sale of Fixed Assets	—	2,269
	1,420	4,800
Deficit for year	9,681	—
	30,269	24,487

EXPENDITURE

	1989 $	1988 $
Victorian Naturalist		
Printing, Illustrating & Despatch	25,184	17,142
Less Grants		
Treasury	(1,500)	(1,500)
	23,684	15,642
Working Expenses		
Postage & Telephone	350	463
Printing & Stationery	300	1,454
Bookkeeping & Typing	1,728	1,510
Rent	1,442	1,210
Herbarium Affiliation Fees, Subscriptions & Donations	459	468
Auditor's Remuneration (Note 4)	300	265
Insurance	317	315
General Expenses	359	877
Natural History Medallion Expenses	—	53
Kinglake Expenses – Rates	572	511
	5,827	7,126
Club Improvement Account – Transfer of Profit on Books Sales	758	1,022
Surplus for year	—	697
	758	1,719
	30,269	24,487

FIELD NATURALISTS CLUB OF VICTORIA
STATEMENT BY MEMBERS OF COUNCIL

In the opinion of the members of the Council:

1. (a) The accompanying Income & Expenditure Account is drawn up so as to give a true and fair view of the results of the company for the financial year ended 31 December 1989.
   (b) The accompanying Balance Sheet is drawn up so as to give a true and fair view of the state of affairs of the company as at the end of the financial year.
   (c) At the date of this statement, there are reasonable grounds to believe that the company will be able to pay its debts as and when they fall due.
2. The accompanying Accounts have been made out in accordance with Australian Accounting Standards and applicable approved accounting standards.

This statement is made in accordance with a resolution of the Members of Council.

SIGNED at MELBOURNE this 30th day of April 1990.

G. Love, President
B. Abbott, Treasurer

FIELD NATURALISTS CLUB OF VICTORIA
BALANCE SHEET AS AT 31 DECEMBER 1989

	Notes	1989 $	1988 $
Current Assets			
Cash	5	27,288	33,976
Receivables	6	—	213
Inventories	7	1,147	1,206
Total Current Assets		28,435	35,395
Non-Current Assets			
Propery, Plant and Equiment	8	9,541	9,541
Investments	9	219,921	156,430
Total Non-Current Assets		229,462	165,971
Total Assets		257,897	201,366
Current Liabilities			
Creditors and Borrowings	10	32,294	18,499
Total Liabilities		32,294	18,499
Net Assets		225,603	182,867
Shareholders' Equity			
Share Capital			
Accumulated Funds	11	225,603	182,867
Total Shareholders' Equity		225,603	182,867

The accompanying notes form part of these financial statements.

FIELD NATURALISTS CLUB OF VICTORIA

NOTES TO AND FORMING PART OF THE ACCOUNTS YEAR ENDED 31 DECEMBER 1989

1. **Statement of Accounting Policies**

The accounts have been prepared in accordance with the accounting standards issued by the Australian accounting bodies and with the disclosure requirements of the Companies (Victoria) Code, Schedule 7 as in operation on 30th September 1987. The accounts have also been prepared on the basis of historical costs and do not take into account changing money values or, except where stated, current valuations of non-current assets. The accounting policies have been consistently applied, unless otherwise stated.

The following is a summary of the significant accounting policies adopted by the Club in the preparation of the accounts:

(a) **Investments**

Investments are valued either at cost less amounts written off for permanent diminution in the value of investments or, at directors' valuation. Dividends and interest are brought to account when received.

(b) **Fixed Assets**

Fixed assets are valued at cost or valuation. No provision has been made for depreciation of the Library as in the opinion of the Council its value greatly exceeds the value shown in the books of account.

(c) **Income Tax**

The Club is not liable to pay income tax.

(d) **Inventories**

Inventories are valued at the lower of cost and net realisable value.

(e) **Club Improvement Account**

Profit on sale of books is capitalised to the club improvement account to reflect realised capital profit.

	1989 $	1988 $
2. **Operating profit** has been determined after:		
(a) Charging as Expense –		
Depreciation of plant & Equipment	—	—
Rental expense on operating leases	1,443	1,210
(b) Crediting as Income –		
Interest received from other persons	—	2,920
Profit on sale of non-current assets	—	—
(c) Recognising Operating Revenue –		
Membership subscriptions	16,051	16,699
Interest	22,041	16,748
Proceeds on disposal of non-current assets	—	2,770
3. **Remuneration of Councillors**		
No remuneration was received by the councillors from the Club for the year ended 31 December 1989	—	—
4. **Auditors' Remuneration**		
Amount received or due and receivable by the auditors for:		
Auditing the Accounts	300	265
Other Services	—	—
5. **Cash**		
Cash at Bank	8,245	13,779
Cash at Bank – Bicentennial Grant	19,043	10,197
Australian Savings Bonds at cost	—	10,000
	27,288	33,976
6. **Receivables**		
Sundry debtors	—	213

7. Inventories		
Badges and sundries	85	85
Books for sale	297	331
Victorian Naturalist Subject Index	765	790
	1,147	1,206
8. Property, Plant & Equipment		
Freehold property –		
Kinglake (gift of Harold C. Frahm)	—	—
Maryborough, Cosslick Reserve, at cost	213	213
	213	213
Library, furniture & equipment		
At cost	9,328	9,328
Less accumulated depreciation	—	—
	9,328	9,328
	9,541	9,541
9. Investments		
General Fund		
Australian Savings Bonds at cost	—	8,300
Esanda Ltd. – Debentures at cost	8,600	8,000
ANZ Savings Bank – Deposit	6,055	5,472
ANZ Term Deposit	20,352	—
Bank of Melbourne – Deposit	4,321	2,443
	39,328	24,215
Building Fund		
Australian Savings Bonds at cost	900	3,100
Esanda Ltd. – Debentures at cost	4,700	5,900
ANZ Banking Group Ltd. – Cash at Bank	4,723	3,591
ANZ Term Deposit	36,446	—
Bank of Melbourne – Deposit	2,172	2,773
	48,941	15,364
Publications Fund		
Australian Savings Bonds at cost	9,100	45,380
Esanda Ltd. – Debentures at cost	2,500	5,000
Telecom – Bonds at cost	—	1,500
ANZ Savings Bank – Deposit	11,956	10,804
ANZ Banking Group Ltd.	17,549	12,248
ANZ Term Deposit	46,067	—
Book Stocks at cost	5,841	6,084
Bank of Melbourne – Deposit	5,158	6,916
	98,171	87,932
Excursion Fund		
Australian Savings Bonds at cost	—	1,000
ANZ Savings Bank – Deposit	11,981	10,826
ANZ Term Deposit	1,221	—
Cash at Bank	26,949	29,052
Sundry Creditors	(6,670)	(11,959)
	33,481	28,919
TOTAL INVESTMENTS	219,921	156,430

10	**Creditors and Borrowings**		
	Subscriptions received in advance	1,540	3,578
	Sundry creditors	9,519	2,533
	M. A. Ingram Trust Grant in hand	2,154	154
	Treasury Grants in hand	38	2,037
	Bicentennial Grant in hand	19,043	10,197
		32,294	18,499
11	**Accumulated Funds**		
	General Fund		
	Balance 1 January	13,853	13,156
	Transfer to D. McInnes Fund	(50)	
	Net Surplus (Deficit) for year	(9,681)	697
	BALANCE at 31 December 1989	4,122	13,853
	Specific Funds		
	Building Funds		
	Balance at 1 January	15,364	13,910
	Net Surplus for year	33,577	1,454
	BALANCE at 31 December 1989	48,941	15,364
	Publications Fund		
	Balance at 1 January	87,932	78,331
	Net Surplus for year	10,239	9,601
	BALANCE at 31 December 1989	98,171	87,932
	Excursion Fund		
	Balance at 1 January	28,919	25,442
	Net Surplus for year	4,562	3,477
	BALANCE at 31 December 1989	33,481	28,919
	Club Improvement Account		
	Balance at 1 January	14,909	13,888
	Net Surplus for year	758	1,021
	BALANCE at 31 December 1989	15,667	14,909
	Kinglake Project Fund		
	Balance at 1 January	1,478	1,313
	Net Surplus for year	2,844	165
	BALANCE at 31 December 1989	4,322	1,478
	Sundry Bequests & Legacies		
	Balance at 1 January	20,412	20,178
	Net Surplus (Deficit) for year	487	234
	BALANCE at 31 December 1989	20,899	20,412
	TOTAL SPECIFIC FUNDS	221,481	169,014
	TOTAL ACCUMULATED FUNDS	225,603	182,867

FIELD NATURALISTS CLUB OF VICTORIA

STATEMENT OF SOURCES AND APPLICATIONS OF FUNDS
YEAR ENDED 31 DECEMBER 1989

	1989 $	1988 $
SOURCES OF FUNDS		
Funds from Operations (Note 1)		
Inflows of funds from operations	39,044	40,586
Less outflows of funds from operations	28,233	26,206
	10,811	14,380
Reduction in Assets		
Current Assets		
Cash	6,688	—
Inventories	59	145
Receivables	213	—
	6,960	145
Non-Current Assets		
Proceeds on disposal of non-current assets	—	2,770
Increase in Liabilities		
Creditors and borrowings	13,794	13,734
Increase in Fund Balance – M. Lester Legacy	31,926	—
	63,491	31,029
APPLICATIONS OF FUNDS		
Increase in Assets		
Current Assets		
Cash	—	15,522
Receivables	—	45
	—	15,567
Other Assets		
Investments	63,491	15,462
	63,491	31,029
NOTE 1:		
Funds from Operations	10,811	14,380
Less – Interest and other items credited direct to Special Funds	20,542	15,952
Add – Profit on disposal of non-current assets	—	2,269
Add – Increase in D. McInnes Fund	50	—
NET OPERATING SURPLUS/(DEFICIT)	(9,681)	697

	1878 $	1988 $
BUILDING FUND		
Balance of Fund at 31 December 1988	15,364	13,910
Interest on investments and bank account	1,651	1,454
Bequest	31,926	—
Balance of Fund at 31 December 1989	48,941	15,364
PUBLICATIONS FUND		
Balance of Fund at 31 December 1988	87,932	78,331
Interest on investments and bank account	10,107	9,393
Sundry	30	33
Surplus for the year from – Fossil Book	102	175
Balance of Fund at 31 December 1989	98,171	87,932

CLUB IMPROVEMENT ACCOUNT		
Balance of Account at 31 December 1988	14,909	13,888
Book sales account profit	758	1,021
Balance of Account at 31 December 1989	15,667	14,909
EXCURSION FUND		
Balance of Fund at 31 December 1988	28,919	25,442
Interest on investments and bank account	3,881	3,389
Surplus on tours	2,646	88
Sundry	530	—
Less: Transfer to Kinglake Project	(2,345)	—
Transfer to Library Fund	(150)	—
Balance of Fund at 31 December 1989	33,481	28,919

FIELD NATURALISTS CLUB OF VICTORIA
BALANCE SHEET AS AT 31 DECEMBER 1989

	1989 $	1988 $
ASSETS		
Current Assets		
Cash at Bank	8,245	13,779
Cash at Bank – Bicentennial Grant	19,043	10,197
Australian Savings Bonds at Cost	—	10,000
Accounts Receivable	—	213
Stocks on Hand at Cost		
Badges & Sundries	85	85
Books for Sale	297	331
Victorian Naturalist Subject Index	765	790
	28,435	35,395
Fixed Assets at Cost		
Library Furniture & Equipment	9,328	9,328
Land – Cosstick Reserve, Maryborough	213	213
	9,541	9,541
Investment of Funds at Cost		
Australian Savings Bonds	—	8,300
Esanda Ltd. Debentures	8,600	8,000
ANZ Term Deposit	20,352	—
ANZ Savings Bank – Deposit	6,055	5,472
Bank of Melbourne – Deposit	4,321	2,443
	39,328	24,215
Building Fund		
Australian Savings Bonds at cost	900	3,100
Esanda Ltd. Debentures at cost	4,700	5,900
Bank of Melbourne – Deposit	2,172	2,773
ANZ Term Deposit	36,446	—
Cash at Bank	4,723	3,591
	48,941	15,364

Publications Fund		
Australian Savings Bonds at cost	9,100	45,380
Esanda Ltd. – Debentures at cost	2,500	5,000
Bank of Melbourne – Deposit	5,158	6,916
Telecom – Bonds at cost	—	1,500
ANZ Savings Bank – Deposit	11,956	10,804
ANZ Term Deposit	46,067	—
Book Stocks at cost	5,841	6,084
Cash at Bank	17,549	12,248
	98,171	87,932
Excursion Fund		
Australian Savings Bonds at cost	—	1,000
ANZ Savings Bank	11,981	10,826
ANZ Term Deposit	1,221	—
Cash at Bank	26,949	29,052
Sundry Creditors	(6,670)	(11,959)
	33,481	28,919
	257,897	201,366

AUDITOR'S REPORT TO THE MEMBERS OF FIELD NATURALISTS CLUB OF VICTORIA

We report that we have audited the accounts of the FIELD NATURALIST CLUB OF VICTORIA in accordance with Australian Auditing Standards.

In our opinion the accompanying accounts, being the Balance Sheet, Statement of Income and Expenditure, Notes to Accounts, Statement of Source and Application of Funds and Statement by Members of the Council, are properly drawn up in accordance with the provisions of the Companies (Victoria) Code 1981 and so as to give a true and fair view of:-

(i) the state of affairs of the company at 31 December, 1989 and of the results of the club for the year ended on that date; and

(ii) that other matters required by Section 269 of that Code to be dealt with in the accounts;

and are in accordance with Australian Accounting Standards and applicable approved accounting standards.

GORDON CLARK & ASSOCIATES — MELBOURNE
Certified Practising Accountants — March 1990

GEOLOGICAL SURVEY OF VICTORIA PUBLICATIONS NOW AVAILABLE

DOOKIE 1:100 000 GEOLOGICAL MAP & GEOLOGICAL SURVEY REPORT NO 87 (70 PAGES, 10 PLATES): Price $20

This full colour geological map features a sequence of Cambrian igneous and sedimentary rocks which formed in a "mid-ocean ridge" environment. They are approximately 550 million years old and as such are amongst the oldest rocks exposed in Victoria. The notes describe the surface and subsurface geology as well as the area's mineral and groundwater potential. The geological history is described and an excursion guide is included.

WARRNAMBOOL 1:50 000 GEOLOGICAL MAP & GEOLOGICAL SURVEY REPORT NO 86 (83 pages, 34 diagrams & photos): Price $20

Full colour map and accompanying explanatory notes describing surface and below surface sedimentary and volcanic rocks. It includes an enlargement, description and the eruption history of Tower Hill Volcano, which at 20,000 years old is amongst the youngest and best preserved volcanoes in Victoria. A comprehensive summary of the geological history of the area from 110 million years ago to the present is given. Comments are made on the economic importance of various stone resources and units which contain groundwater and oil and gas potential.

CASTLEMAINE 1:100 000 DEEP LEADS MAP: Price $4

Full colour map with insets showing simplified geology with mine shaft locations and positions of deep leads.

PALAEOZOIC STRATOTECTONIC & STRUCTURAL FEATURES OF VICTORIA (1:1 000 000): Price $7.50

Full colour map showing the Palaeozoic stratotectonic units in Victoria with the main structural features superimposed. This is the first time such features have been published on a map at this scale allowing a statewide overview to be readily gained.

PALAEOZOIC STRUCTURAL FEATURES OF VICTORIA (1:1 000 000): Price $7.50

The map gives a broad overview of bedrock structural trends in Victoria useful for teaching, research and display purposes. The features are colour coded reflecting the association of various features with certain time periods or tectonic events.

VICTORIA's GOLD PROVINCES (1:1 000 000): Price $7.50

This full colour map for general display or teaching purposes shows the main gold provinces with summary text on gold in Victoria.

AVAILABLE FROM

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FNCV NEW MEMBERS

Metropolitan

Rosalind Moore and Jeremy Price, Doncaster.
Dean Haywood and Alison Haywood, Northcote.
Jennifer Gassin and Robert Gassin, Knoxfield.
Barry and Margaret Dowling, Richmond.
Dr. Richard Williams and Dr. Bronwyn Myers, East St. Kilda.
Shirley Shannor, Hampton.
Jan Pfeiffer, Greensborough.
Graeme Challis, Melbourne.
Val Define, South Caulfield.
Anne Casey, West Brunswick.
Ruth Akie, Canterbury.
Monique Planter, Eltham.
Jean Moy, Kew.
Malcolm Warren, Blairgowrie.
Peter Himing, Epping.

Country

Patricia Murphy, Ballarat.
Jeanette Tyers, Rhyll.
Ian Dowling, McCrae.
Susan Taylor, Yarram.

Retired

J.M. McCoy, Boronia.

Field Naturalists Club of Victoria

In which is incorporated the Microscopical Society of Victoria

Established 1880

Registered Office: FNCV, c/ National Herbarium, Birdwood Avenue, South Yarra, 3141.

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron
His Excellency, The Rev Dr John Davis McCaughey, The Governor of Victoria.

Key Office-Bearers 1989-1990

President:

Vice President: Mr. ARTHUR FARNSWORTH, FNCV, National Herbarium, Birdwood Avenue, South Yarra, 3141.

Hon. Secretary: Mr. JULIAN GRUSOVIN, 1 Warriner Court, East Oakleigh, 3166. (543 8627 A.H.)

Hon. Treasurer: Mr. BRUCE ABBOTT, 4/597 Orrong Road, Armadale, 3143. (529 4301 A.H.)

Subscription Secretary: Ms DIANNE CHAMBERS, FNCV, c/ National Herbarium, Birdwood Avenue, South Yarra, 3141 (387 5146).

Editors: ROBYN WATSON and TIM OFFOR, FNCV, c/ National Herbarium, Birdwood Avenue, South Yarra, 3141 (419 3532).

Librarian: Mrs. SHEILA HOUGHTON, FNCV, c/ National Herbarium, Birdwood Avenue, South Yarra, 3141 (551 2708)

Acting Excursion Secretary: DOROTHY MAHLER (850 9379 A.H.).

Club Reporter: Vacant.

Conservation Co-ordinator: Mr. WIL ASHBURNER, National Herbarium, Birdwood Avenue, South Yarra, 3141.

Sales Officer (Books): Vacant.

Sales Officer (Victorian Naturalist only): Mr. D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (541 2427)

Programme Secretary: Vacant.

Publicity Officer: Miss Margaret Potter, 1/249 Highfield Road, Burwood, 3125. (889 2779).

Group Secretaries

Botany: Miss MARGARET POTTER, 1/249 Highfield Road, Burwood, 3125 (889 2779).

Day Group: Mr. D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (541 2427)

Geology: Miss HELEN BARTOSZEWICZ, 16 Euroa Avenue, Nth. Sunshine, 3020 (311 5106 A.H.)

Fauna Survey: Mr. JULIAN GRUSOVIN, 1 Warriner Court, East Oakleigh, 3166. (542 2396 B.H. and 543 8627 A.H.)

Microscopical: Mrs. ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1988

Metropolitan Members (03 area code)	$25.00
Joint Metropolitan Members	$27.00
Country/Interstate/Retired Members	$23.00
Joint Country/Interstate/Retired Members	$25.00
Student (full-time)	$18.00
Junior (under 18; no Victorian Naturalist)	$5.00
Subscription to Victorian Naturalist	$23.00
Overseas Subscription to Victorian Naturalist	$30.00
Affiliated Clubs	$25.00
Subscriber Clubs	$23.00
Individual Journals	$3.50
Late Fee (Renewing Members), after end of March	$2.00

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The Victorian Naturalist

Vol. 107 (3) June 1990

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since 1884

FNCV DIARY

General Meetings

Held on the **second monday** of the month (except for public holidays), 8.00 p.m. at the National Herbarium, corner of Birdwood Avenue and Dallas Brooks Drive, South Yarra. Meetings include a talk by a guest speaker. All members of the public are welcome.

Monday 13th August
Marine life of Heron Reef.
Mrs. Julie Marshall

Monday 10th September
To be announced.

FNCV Excursions

Special notice: some excursions will be held on Saturdays since public transport is more frequent than on Sundays. For details of excursions contact Dorothy Mahler (Ph. 850 9379 after 6.00 p.m.).

Sunday 5th August
Blackburn Lake. Meet at Blackburn Station at 10.30 a.m. Catch 10.03 a.m. train at Flinders Street Station.

Sunday 2nd September
The 100 Acres, Park Orchards. Meeting 10.30 a.m., Melways: 35 F9. Train travellers: Train leaves Flinders St. Station 9.23 a.m. Dorothy Mahler will pick up travellers from Ringwood Station. Please ring Dorothy on 850 9379 (H) or 265 2399 (W) if you are travelling by train to organise pick up.

Group Activities

Fauna Survey Group

Meetings (First Tuesday in the month)

Tuesday 7th August

Botany Group

Group Meetings (Second Thursday)

Thursday 9th August
From Dalhousie to Western Queensland. Margaret Corrick.

Thursday 13th September
Victoria's Rainforests. David Cameron.

Excursions

Saturday 28th July
Mosses. Warburton area. Leader Arthur Thies.

Saturday 25th August
Cranbourne annexe of the Royal Botanic Gardens. Leader to be arranged.

Geology Group

Group Meetings (First Wednesday)

Wednesday 8th August

Microscopical Group

Group Meetings (Third Wednesday)

Wednesday 15th August
Polarised light and the microscope.

Wednesday 19th September
Pollen slides. Members to make and display.

Hawthorn Juniors

Group Meetings (Last Friday)

Friday 27th July
Alpine Wildlife.

Friday 31st August
To be arranged.

Contacts: Gerard Marantelli 497 2281
Peter Kelleher 337 6405

Apology

The editors apologise for the lateness of the April and June issues of *The Victorian Naturalist*. Times have been lean both for completed articles and assistance with production. We believe that we have remedied the situation. The August issue is in production and will be out on time.

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The Victorian Naturalist

Volume 107 (3) June, 1990

Editors: Tim Offor and Robyn Watson.

F.N.C.V.

ISSN 0042-5184

Cover photo: London Bridge has fallen down. See Eric Bird's explanation on page 86. Photo: Eric Bird.

Notes on fruit condition, germinability and seedling morphology of *Olearia pannosa* Hook. (Velvet Daisy-bush)

M. J. Bartley*

Introduction

Olearia pannosa Hook. (Family Asteraceae) is rare in Victoria and listed as "vulnerable" – at risk of becoming extinct in the long term if further depleted or if threatening processes continue – by Scarlett (1984) and Gullan, Cheal and Walsh (in prep.). Wisniewski, Scarlett and Parsons (1987) listed for Victoria a total of 12 extant stands and four sites from which the species had previously been recorded but may now be extinct[1]. They noted that several stands are threatened by browsing by mammals, erosion, roadworks and/or rubbish dumping.

Despite recording numerous sucker-shoots from decumbent stems of mature plants, Wisniewski *et al.* (1987) found only occasional seedlings. Furthermore, they found that at most only 3% of fruits contained developed, apparently viable seeds and that fruit damage due to insect predation was common. A trial of the few available developed fruits suggested that time to first germination was more than halved when seeds were imbibed free of the fruit wall, though the final proportion of germinants was similar to that for fruits inbibed whole. This suggests some temporary inhibition of germination by the fruit wall.

The aims of the present work were to assess fruit condition from three new collections, to further investigate germination and to describe the morphology and growth of seedlings.

* Department of Botany, La Trobe University, Bundoora, Victoria 3083, Australia.

1. Wisniewski *et al.* (1987) referred these plants to *Olearia* sp. aff. *pannosa* Hook., but N.S. Lander (PERTH) has since confirmed that they belong to the Type form of *O. pannosa* Hook. (pers. comm. to R.F. Parsons), so the affinity status has not been retained here.

Two of the new fruit collections were by Mr. Frank Lawrence from a population on private property near Point Addis, Victoria, and the third by the present author from Site 12 of Wisniewski *et al.* (1987), also near Point Addis. Each collection was assumed to represent fruits derived solely from the preceding flowering period. The fruiting period extends from December to May (Wisniewski *et al.*, 1987).

Fruit condition

Assessment of fruit condition was made using the three categories specified by Wisniewski *et al.* (1987): (i) fruit unexpanded or empty, (ii) partially or completely damaged by predation and (iii) filled fruits with developed and apparently viable seed.

Results of the assessment of fruits from the new collections, plus those of one comparable collection from Site 12 reported by Wisniewski *et al.* (1987), are given in Table 1.

The 1070 fruits collected on 15 February 1988 came from 20 heads, with a mean of 53.5 fruits per head, a standard deviation of 15.3 and an acceptably Normal distribution. Number of heads per plant was assessed in the same population for a sample of 54 large plants (defined by Wisniewski *et al.* (1987) to be plants greater than 30 cm in height and having four or more shoots). The number varied from zero to 28 with a distribution very skewed towards fewer heads. The mean was 2.1 heads (plus 0.3 buds) per large plant, though it is probable that this figure would vary annually and between populations, because more prolific flowering has been seen in the past.

The collections by F. Lawrence on private property represent two fruit crops

Table 1. Condition of *Olearia pannosa* fruits.

Site	Date collected	Total number examined	Proportion of fruits (%) Unexpanded or empty	Partly eaten by insects	Filled
Lawrence	3 May 1987	1260	23.0	69.5	7.5
Lawrence	6 Dec 1987	881	19.0	72.5	8.5
I2	19 Mar 1987	291	89.7	7.6	2.7*
I2	15 Feb 1988	1070	70.0	27.9	2.1

* Data from Wisniewski *et al.* (1987), used with permission.

from the same population, the first near the end of one fruiting period (May) and the second early in the next (December). There was no apparent difference in size or shape of the mature fruits, though a roseate tint to the basal third of the pappus was more evident in the December Fruits.

Analysis of a contingency table using the three fruit condition categories and the four collections listed in Table 1 showed that fruit condition was not independent of collection ($X_4^2 = 1679$, $p \ll 0.001$ for 6 degrees of freedom in the contingency table). Lawrence's two collections were not significantly different at the 5% level ($X_2^2 = 5.29$, $0.05 < p < 0.10$), but the two collections from Site I2 were ($X_2^2 = 52.3$, $p < 0.001$). These results imply that fruit condition may vary between populations and within a population from year to year.

Fruit damage

The principal cause of fruit damage appears to be a beetle, *Corticaria* sp. (Family Lathridiidae). Individuals were found in all of twenty heads examined from Site I2, both between and inside fruits. Species in this genus are noted for consuming moulds and other fungi often associated with stored food products (C. McPhee, pers. comm.). The *Olearia* heads commonly had spider webs between the fruits and occasionally fungal hyphae were present. Spores of the common saprophytic fungus, *Alternaria* sp. (Class Hyphomycetes, Family Dematiaceae) were prolific in scrapings from fruit walls in all fruit conditions. These would most likely germinate after fruits had fallen, but also in heads wet from rain or dew.

The fruit wall scrapings contained mites which may also eat the fungal mycelia (P.J. Keane, pers. comm.). Spiders may opportunistically prey on either or both the mites and beetles.

The beetles also appear to be attracted to eat rotting infertile ovules or shrivelled seed tissue in the undeveloped fruits, rather than healthy, developing tissue. Very few filled fruits showed significant insect damage and some collections with high overall levels of damage also had relatively high numbers of filled, undamaged fruits. Thus predation may not be a primary factor in the low seed-set, except where damage is widespread at an early stage and affects seed development (Fig. 1).

The data for Lawrence's population suggest that damage can be as high near the beginning of the fruiting period as near the end. Attack appears to begin before fruits ripen and the severe damage to some small, poorly developed heads from the I2 population (Fig. 1) suggests that attack may even occur early in flowering. Burrowing into the receptacle was evident in 25% of the heads sampled and would certainly impair development of some of the fruits (Fig. 1). In general, mature filled fruits were not confined to any particular zone of the disc.

Beetle faecal deposits and possibly also secretions combine with the spider webs and fungal hyphae to bind the fruits together in the heads, thereby securing both shelter and a food source. Binding occurs

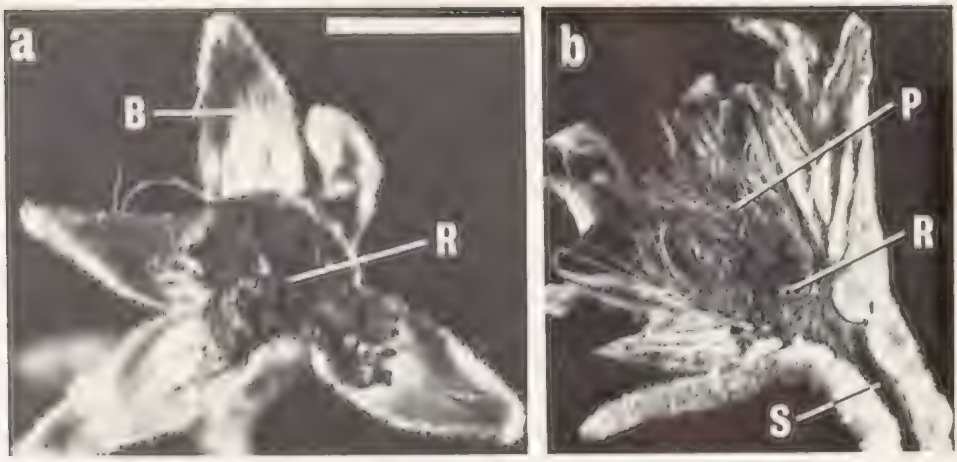

Fig. 1. Insect damaged, poorly developed heads of *Olearia pannosa*, showing (a) insect-burrowed receptacle and (b) damage to fruits and receptacle (longitudinally halved head). B – involucral bract, P – pappus, R – receptacle and S – hollow scape. Scale bar is 5 mm.

in at least one other composite, *Microseris scapigera* (Sol. ex Cunn.) Schultz-Bip., and species with long achenes may be most susceptible (N.H. Scarlett, pers. comm.).

Germination

Possible obstructions to germination which might account for the variation in time to germination observed by Wisniewski *et al.* (1987) include blocking by the fruit wall of light to the embryo and/or chemical inhibition by substances leaching from the fruit wall during imbibition.

Filled fruits from the 3 May 1987 collection were used to screen the effects on germination of the following treatments: A. whole fruits in light; B. fruits with wall removed but placed in liquid contact with the seeds, darkness; C. seeds only, light; D. seeds only, darkness. Equivalent samples of thirty fruits or seeds were used per treatment.

The fruits or seeds were surface-sterilized (2% sodium hypochlorite with a wetting agent for 0.5 hr then rinsed with sterile distilled water) and placed on sterile moist seed test paper in Petri dishes (10 fruits or seeds per dish) in a growth cabinet. Light and temperatire were cycled (12 hr of 250 μE m^{-2} sec^{-1} PAR at 18 °C alternating with 12 hr of darkness at 15 °C). Dishes in treatments B and D were placed under black cloth and examined for germinants using a dim green (non phytochrome-stimulating) lamp. One dose of "Karathane" (Rentokil Pty. Ltd.) was applied after one week to kill germinated fungal spores on the fruit walls.

The 20 to 26 days taken for the first germinants to appear (Fig. 2) is similar to that reported by Wisniewski *et al.* (1987) for seeds removed from their fruit walls. However, there was no delay in germination of whole fruits and neither light nor the presence of the fruit wall appeared to affect the subsequent rate of germination.

The final germination scores for the treatments were A: 73%, B: 83%; C: 83% and D: 90%, which were not significantly different at the 5% level ($X^2_3 = 7.11$, $0.05 < p < 0.10$).

Morphology

Germinants from the trial were planted into a coarse sandy loam, individually in

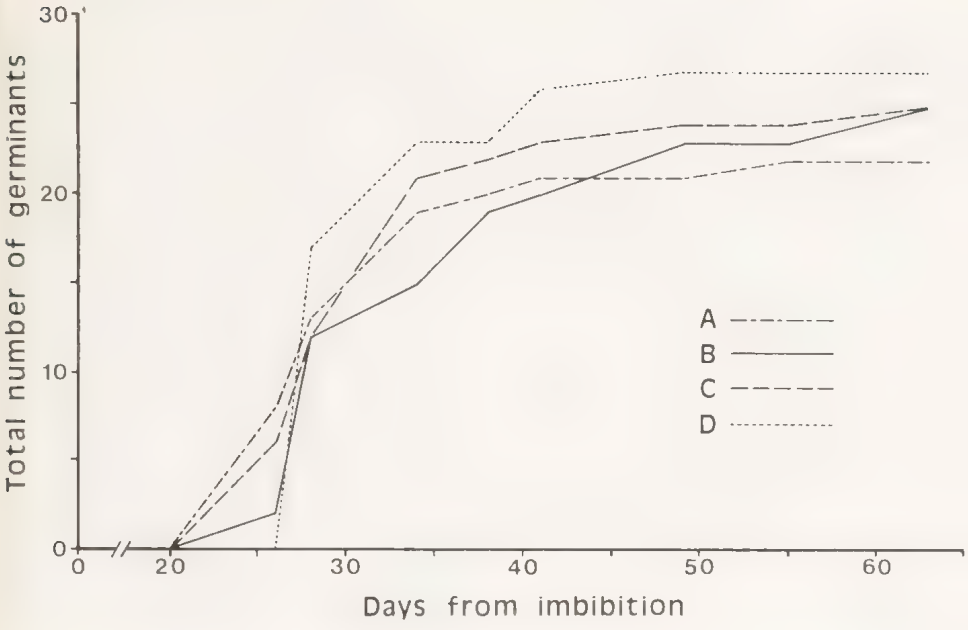

Fig. 2. Rates of germination of *Olearia pannosa* seeds for four treatments, A-D (see text).

7.5 cm diameter pots, and grown in a glasshouse and subsequently a shadehouse between September 1987 and January 1988. Growth was slow and the shoot axes were only 0.5-2.0 cm long after 2 months. By four months the majority of seedlings had developed axillary shoots from the first or second leaf axils and the primary apices were 1.5-3.5 cm tall. Older seedlings (*ca.* 10 months, from a different seed source) had thick stem bases, but also little stem length in their first season.

The expanded cotyledons were thick, convex, oblong to elliptic (0.5-1.0 cm long by 0.2-0.4 cm wide) and glabrous. Early leaves (Fig. 3) were round to oblong, up to 1.9 cm long, petiolate, tomentose below and sparsely hairy above. Leaves mostly appeared adult in form by the sixth or seventh leaf, though smaller (about 3.5 cm long by 2.5 cm wide) and often with sparsely and minutely toothed margins (Fig. 4). Teeth were not evident on young leaves of older plants and this difference may

Fig. 3. Two month old seedling of *Olearia pannosa* showing cotyledons (C), early petiolate leaves (E) and development of axillary shoots (A). Scale bar is 10 mm.

serve to distinguish seedlings from small sucker-shoots in the field.

Wisniewski *et al.* (1987) noted the presence of tuberous roots. These structures appeared quite early (from about two months), high on the root axis. By four months they were various lengths, but most had no attendant fine root systems (Fig. 4).

The observed slow shoot growth is unlikely to have been a result of lack of nutrients in the potting mixture used. Two other perennial daisy species from the region have shown considerably more rapid growth under the same conditions. The nutrient status of the Point Addis soils is likely to be lower than that of the potting mixture, though no assays have been attempted.

Fig. 4. Four month old seedling of *Olearia pannosa* showing fine marginal teeth on upper leaf (M) and tuberous root development (T) high on the tap root (R). Scale bar is 20 mm.

During autumn 1988, the seedlings were re-planted into a large wooden box containing sandy loam in an open, sunny position at La Trobe University. Growth during the following spring and summer resulted in an average plant height of approximately 0.4 metres, but none flowered until spring 1989. Flowering was prolific (up to 46 heads per plant) and continued from October to December, with fruit maturing from November to early January 1990. Filled fruits were obvious in many of the heads, but samples have not yet been scored. There was little apparent fruit-damage.

Plant condition after flowering and fruiting seemed poor. Many leaves senesced and fell and, although the soil was watered when necessary over summer, only nine of 28 plants have remained alive. Apical shoots have mostly survived and axillary shoots have contributed much new leaf material.

Whole, mature plants excavated from the field, trimmed and potted have subsequently developed several new shoots from renascent buds on old parts of stems.

Conclusions

Taking into account both the data on fruit condition and on percentage germination of filled fruits, only 0.6-7.7% of all fruits contain germinable seed. There are 36-77 fruits per head and a mean of 2.1 heads per plant in the population sampled at Site 12. For a population of 35 large plants (the mean number per site in 1986-87 listed in Table 3 of Wisniewski *et al.* (1987)), these figures give 16-436 germinants per year. If even the lowest number survived to maturity, an average population could maintain its numbers, particularly given the apparent longevity of individuals of this species. Nevertheless, such small populations of a species which probably relies on cross pollination (Schaumann, Barker and Greig (1987), referring to the genus) are at risk of eventual decline because the small gene-

pool can be significantly reduced by the loss of even a few mature plants. In 10 populations re-sampled after 7-8 years, Wisniewski *et al.* (1987) found both increases and marked decreases in numbers of large plants.

Fruits appear to disperse quite close to the parent plants (most within *ca.* 3 m radius) judging from seedling distribution in the I2 population. The achenes are quite heavy in relation to the size of the pappus and fruits fall at a steep angle when released in moderate wind. Animal vectors are unknown. Because of this limited seed dispersal, physical expansion of populations is likely to be slow and competition amongst increasing numbers in a population could result in significant attrition.

The plants have slow initial shoot growth and appear to invest early in underground storage structure. Axillary vegetative buds seem to be readily expressed and there are dormant buds in older stems which could be released after plant damage such as by fire, browsing or other physical injury.

Continued monitoring of populations is necessary to allow better evaluation of risks to the species' survival in Victoria. Destruction of the plants and/or their habitat is likely to pose a greater threat than insect predation or the probably normally low seed-set.

Acknowledgments

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Cliff instability on the Victorian coast

Eric Bird*

This article is based on a talk given to the Geology Group of the Field Naturalists Club of Victoria at the National Herbarium on 2nd May 1990.

On January the 1st 1990 a portion of sandstone cliff at Beaumaris collapsed, killing a 3-year old boy, and a fortnight later the inner arch of London Bridge, near Port Campbell, fell into the sea just after two young people had walked across it: they were stranded for several hours on the outlying archway, until rescued by police helicopter.

The two incidents have focussed attention on the question of cliff instability on the Victorian coast, especially on the part of those concerned with public safety, and with legal and insurance problems.

Cliff recession

It is acknowledged that cliffs are dangerous places: they are inherently retreating features. Their rate of recession varies with geological factors, notably the resistance and structure of the exposed rock formations, and with geomorphological factors, such as the form of the adjacent shore and nearshore zones and the degree of exposure to strong wave action. Cliffs on hard rock formations, such as the Wilson's Promontory granite, have receded very little over the past few thousand years, whereas cliffs cut into soft sands and clays may retreat a metre or more each year.

Cliff recession usually proceeds by way of basal undercutting, caused largely by wave scour, followed by occasional slumping of the weakened cliff face. Disintergration of a coastal rock formation is aided by the presence of joints, faults and bedding planes[1]. Factors which favour rapid cliff recession include a seaward dip of the rock outcrops, especially where permeable strata rest upon an impermeable basement, and are loosened and undermined by seaward seepage down the interface; the absence of a protective shore platform, rocky outcrops or a wide beach in front of the cliff; and exposure to strong wave action arriving through relatively deep nearshore water.

Cliff falls may be triggered by tectonic movements. During the 1931 earthquake at Napier, New Zealand, major falls occurred along the high cliffs of Hawke Bay, producing extensive talus aprons, and in the 1964 Alaskan earthquake there was extensive cliff slumping near Anchorage, in an area now known as Earthquake Park. Such earthquakes usually produce multiple cliff falls, rather than one localised collapse. Cliff falls are more often caused by the impact of severe storms, or by exceptionally wet weather inducing strong groundwater seepage. Expansion and contraction of coastal rock formations with alternations of heating and cooling tends to widen joints, and may provoke a cliff fall, and repeated wetting (by rainfall and sea spray) and drying also promotes surficial disintegration. Exudation of fine-grained sediment and precipitation of accretionary features may overload the cliff face, and so lead to instability. In high latitudes there are many cliff falls in winter as a result of the freezing and thawing of coastal rocks, but this does not happen

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1. Joints are fractures that develop in a rock mass as the result of shrinkage, as during the drying-out of a marine formation raised above sea level or the cooling of igneous rocks such as granite and basalt. They differ from faults in that there is no dislocation of the adjacent rock formations. Bedding planes are divisions between sedimentary rock strata, generally due to variations or brief interruptions in sedimentation: they are initially horizontal, or nearly so, and may have been subsequently tilted or folded. Bedding planes that are emphasised by the shrinkage of a rock formation can be termed bedding joints.

in Victoria. Finally, as Emery and Kuhn (1982) emphasised, cliff erosion may be caused by cliff-top loading where buildings are constructed, or by the increases in runoff and seepage that often accompany such development.

Typically, cliff recession is a cyclic process: a steep to vertical cliff is undercut, and a cliff fall produces a talus fan or apron which is then undercut and consumed by the sea until the cliff is again exposed to wave attack at its base (Fig. 1 a-c). It is difficult to assess an average rate of cliff recession, because the retreat takes place intermittently by sectors, but it has been shown that the crests of vertical chalk cliffs of southern England, which retreat by recurrent local cliff falls, have been receding at up to 76 cm/year (May and Heeps 1985).

Several parts of the Victorian coastline consist of cliffs that are intermittently retreating. They include the soft Tertiary limestones of the Port Campbell district and similar weak Tertiary sands and clays between Anglesea and Torquay, and on the north shore of the Bellarine Peninsula. Cliffs cut in Tertiary sandstones have been retreating on the east coast of Port Phillip Bay between Brighton and Beaumaris and from Frankston to Balcombe Bay. Cliff falls have also occurred on weathered volcanic formations and tuffs in the Portland district, on Pleistocene dune calcarenites near Warrnambool and between Barwon Heads and Cape Schanck, and on Cretaceous mudstones on the Otways coast and between San Remo and Inverloch, but in each of these situations bordering shore platforms or rocky areas have reduced the intensity of wave attack. Minor falls have occurred on cliffs of Newer Basalt between Cape Schanck and Balnarring and on the western and southern shores of Phillip Island, but these formations are relatively resistant, and often fronted by shore platforms. Changes have been very slow on cliffs and steep

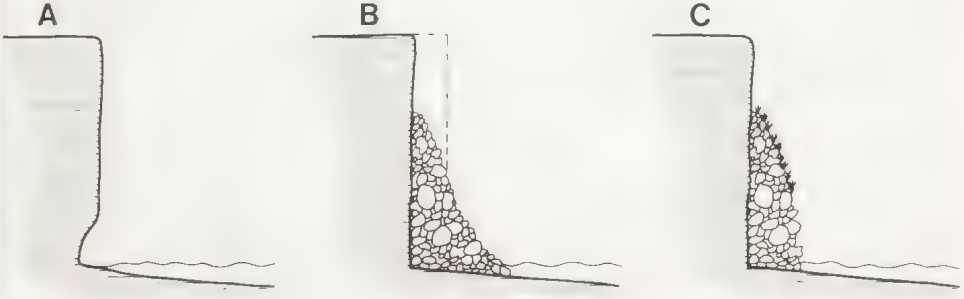

Fig. 1 a-c. Cyclic retreat of a cliff, resulting from undercutting until a cliff fall produces a talus fan which is cut back by marine erosion until the cliff base is once more exposed to wave attack.

Fig. 2. The coastline at Loch Ard Gorge, east of Port Campbell, consists of rectangular promontories, islands and inlets, the outlines of which are closely related to the pattern of NE-SW and NW-SE vertical jointing.

rocky shores on such resistant formations as the Mount Martha granodiorite, the granites of Wilson's Promontory and the Palaeozoic formations of Cape Liptrap and East Gippsland.

Examples of cliff instability will be examined from the Port Campbell coast and from the shores of Port Phillip Bay between Sandringham and Beaumaris.

Port Campbell coast

The cliffs east and west of Port Campbell, which locally rise more than 30 metres above sea level, are cut into the horizontal or gently-dipping, well-stratified and strongly-jointed calcareous formation known as the Port Campbell Limestone (Baker 1943). They are exposed to strong south-westerly waves approaching through relatively deep water across a narrow sector of the Australian continental shelf. There are minor variations in the resistance of the strata, harder layers standing out as slight ledges, and the upper parts of the formation are sufficiently indurated by secondary carbonate precipitation to maintain very steep to vertical (80°-90°) cliff profiles. Their outlines have been strongly influenced by erosion along intersecting patterns of steep to vertical joints, especially those tending NW-SW and SW-NE. Breakaways have occurred, leaving joint planes exposed on the cliff face. The shapes of headlands, inlets and stacks reflect the joint pattern, especially in the Loch-Ard Gorge area (Fig. 2). Apart from some minor ledges of harder limestone locally at the cliff base, due possible to induration by carbonates precipitated from the sea water, shore platforms are poorly developed, and there are only minor beaches. In general, the cliff base is fronted by a smoothly declining sea floor, except where there are residual offshore stacks and reefs.

These cliffs have been retreating for the past six thousand years, since the rising Late Quaternary marine transgression brought the sea to approximately its present level. Coastal waterfalls and hanging valleys indicate that cliff retreat has been rapid in comparison with stream incision and valley deepening. During the past century, cliff recession has been by way of localised rock falls, most of which have been unrecorded. The occurrence of these falls is indicated by paler scars on the generally yellow-brown cliff faces, and by cliff-base talus heaps in various stages of reduction by marine attack. Vegetation has developed on the more persistent talus heaps. Documented changes include the betrunking of Elephant Rock and the reduction of Sphinx Rock during a major storm in 1935, and a major fall west of Sentinel Rock in 1939 (Baker 1943). In the latter, a sector of cliff about 200 metres long and up to 12.2 metres wide suddenly collapsed into the sea, producing an apron of blocky talus, parts of which still persist after half a century of marine erosion (Fig. 3). Baker recorded that when observers from Port Campbell arrived on the scene a few minutes after the collapse they found the ground surface still quivering.

Incipient cliff falls may be indicated by cracks in the cliff face, or behind the cliff crest where joints have begun to widen, and there are often minor falls in advance of a major collapse. Some falls have occurred during stormy weather, when waves break heavily against, and even over, these high cliffs (Baker 1958); others after spells of very wet weather, when the coastal rock formations are saturated; but some have been sudden and unexpected, when the weather was calm and dry.

This was the situation with the inner arch at London Bridge. This internationally famous landform formed as the result of penetration by marine erosion along

Fig. 3. View eastward to Sentinel Rock, where a major cliff fall (X) occurred in 1939, producing a talus apron, the remains of which are still visible in this photograph taken fifty years later.

joint planes through a long narrow promontory, to form two caves roofed by slightly harder limestone (Fig. 4 A,B). Examination of historical sketches and photographs has shown little evidence of change in this feature since the early years of the present century, but close inspection of photographs taken during the past twenty years shows that small fragments of rock had disappeared from the edges of the underside of the arch. The joints along which the collapse occurred were not conspicuous, however, and there was no reason to suppose that a collapse was imminent when the structure gave way on January the 15th. The weather had been fine, with only a moderate swell, for the previous several days, and there was no evidence of any unusual tectonic activity. Reports of a minor tremor at Port Campbell have not been confirmed, and some have suggested that (as in 1939) the noise and vibration of the rock fall were registered in the town, about 6 kilometres east of London Bridge.

The residual outlying arch still looks secure (Fig. 5), but in due course this, too, will collapse, leaving two residual stacks (Fig. 4 C-E). Some of the Twelve Apostles may well have originated as the result of collapse of similar natural arches through promontories. Several other sectors of the Port Campbell cliffs show cracks indicative of rock falls to come, and the whole stretch of high vertical cliffs should be regarded as hazardous, especially during wet or stormy weather.

Black Rock Point

Cliffed promontories persist on Melbourne's bayside coast, notably at Red Bluff and Black Rock Point, where minor anticlines bring up the relatively resistant basement of Black Rock Sandstone, overlain by softer Red Bluff Sand. The sequence is well displayed at Black Rock Point, where a structural shore platform has developed on the Black Rock Sandstone, and gullied cliffs have been cut in the overlying Red Bluff Sand (Fig. 6).

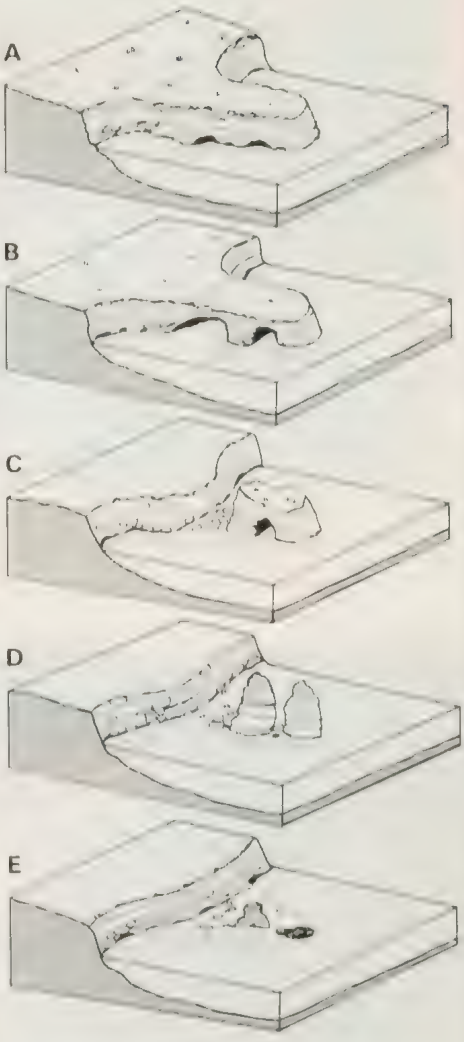

Fig. 4. Diagrams to show the evolution of the double archway at London Bridge as the result of the formation and growth of caves through an elongated promontory (A-B). The recent collapse of the inner arch left an 'island archway' (C), and a further collapse will leave two stacks to be reduced by marine erosion (D-E).

Fig. 5. London Bridge on January the 16th 1990, immediately following the collapse of the inner arch, which disintergrated into large angular joint-bounded blocks as it fell into the sea.

Fig. 6. The rilled cliffs in Red Bluff Sand at Black Rock Point have retreated as the result of erosion by subaerial runoff and intermittent basal undercutting by storm waves, exposing the darker underlying Black Rock Sandstone as a shore platform.

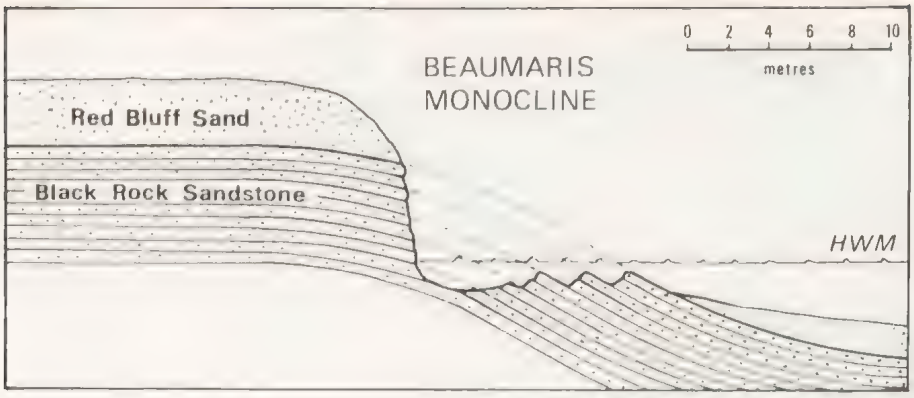

Fig. 7. Relationship of cliffs cut in Black Rock Sandstone to the Beaumaris Monocline. HWM = high water mark.

Successive surveys of this cliff have shown the importance of seepage and runoff following heavy rains, in cutting the cliff-face rills and carrying down fans of soft sandy material to the cliff base, which are then washed away by waves at high tide. Alternations of erosion by this subaerial runoff and basal undercutting by high tide storm waves have combined to cut this cliff back, but the rate of recession has been very slow (Bird, Cullen and Rosengren 1973; Bird and Rosengren 1986, 1987). A minor promontory has, however, been breached to form an arch, which collapsed in the winter of 1981 to leave a stack, reproducing on a small scale the sequence seen at London Bridge (Fig. 5 in Bird 1987).

Cliff recession at Black Rock Point would certainly have been much more rapid if it were not for the protective shore platform of Black Rock Sandstone, the persistence of which has been aided by the induration which occurs in the upper intertidal and supratidal zones on such outcrops. This is the result of accumulation of iron compounds leached from internal and higher parts of the rock formation by percolating groundwater and precipitated from seepage in the surficial zone. Similar hardening has been noted on ferruginous rock outcrops at several locations around Port Phillip Bay, notably along the Mornington coast, where it has also retarded cliff retreat.

Beaumaris cliffs

The undulating Black Rock Sandstone formation rises southward before plunging across the Beaumaris Monocline, and outcrops parallel to this flexure in the line of cliffs facing south-east between Table Rock Point and Mentone (Fig. 7). These are vertical cliffs up to 12 metres high, with a local capping of softer Red Bluff Sand. They have been retreating as a result of intermittent minor rock falls, several of which have occurred during the past two decades. The falls have occurred along joint planes which intersect the Black Rock Sandstone parallel and oblique to the cliff face. As the rock disintergrates, it breaks up into joint-bounded blocks, which fall to the base of the cliffs. Each fall has produced a scar in the cliff and a heap of ferruginous sandstone boulders at the back of the shore, which soon become indurated by the process mentioned previously, and are then consumed only slowly by marine erosion. Otherwise, there is very little beach material, and the sea floor declines gradually beneath Beaumaris Bay.

As it is not exposed to the prevailing south-westerly winds, this stretch of cliffs receives strong wave action only occasionally, during episodes of strong southerly or south-easterly wind action. The overall rate of recession in recent decades is too small to be measurable when comparing early maps and air photographs with the present outline. Cliff crest recession as the result of a rock fall is usually very small, up to a few centimetres. The fall on January the 1st 1990, at a site south-west of Keefer's Pier (near the Beaumaris Hotel), was on a cliff sector about 3 metres wide and up to 4 metres high, and did not produce any cliff-crest recession (Fig. 8).

This fall took place along part of a joint plane that had been widened by penetrating tree roots. The weather at the time was fine and calm, and there is no evidence of any tectonic triggering. There was some speculation as to whether heavy lorry traffic along Beach Road, only a few metres in from the cliff crest, had contributed to this instability, but there was no heavy lorry traffic on New Years' Day. It is unlikely that the fall would have attracted much attention if it were not for the death of the small child: the chances of someone being at precisely this point just when such a rock fall occurred were extremely low. Nevertheless, the incident drew attention to the fact that cliffs are dangerous places, and that anyone who lingers near their crests or immediately beneath them is in fact taking a risk, albeit a small one in comparison, say, with venturing on to a Victorian highway.

In April 1990 another cliff fall occurred, close to the site of the January event. Further falls may be expected here, especially where the cliff base has been undercut by marine erosion, or by people seeking Cheltenhamian fossils from the Mio-Pliocene marls at the base of the Black Rock Sandstone (Bird 1987).

Sandringham cliffs

One way in which cliff hazards develop is illustrated on Sandringham beach, to the north of Red Bluff. The coast here formerly consisted of steep vegetated bluffs behind a wide sandy beach, but this beach, like others on the east coast of Port Phillip Bay, has been gradually depleted in recent decades. There is a marked seasonal alternation on these beaches: during winter, westerly and north-westerly waves drive beach sand southwards, while in summer southerly waves become dominant, and move the sand back towards the north. Consequently, in April and May, when the first winter storms occur, the southern parts are much depleted. Under these conditions the Sandringham bluffs have been undercut, and converted into increasingly high cliffs in soft clayey Red Bluff Sand, receding as the result of basal undercutting and intermittent slumping.

Response to cliff recession

All cliffs are hazardous, but when accidents occur there is invariably a demand that something be done to make them safer. Where rapid cliff recession threatens developed property, the traditional response has been to stabilise the cliffs, usually by constructing a basal sea wall or boulder rampart, and landscaping the cliff to a more gradually sloping bluff which can be stabilised with planted vegetation. This is what has happened to receding cliffs on several sectors of Melbourne's bayside coast, notably between Green Point and Hampton and from Black Rock to Quiet Corner. Few people now realise that these stabilised bluffs and undercliff walk are the outcome of engineering works in the late nineteen-thirties, replacing vertical cliffs in soft Red Bluff Sand, which had been receding at about a metre per year, and were threatening to undermine Beach Road (Mackenzie 1939).

In 1973 there were proposals to treat the cliffs at Black Rock Point in this way, but there were protests from local residents, who wanted them preserved as an element of scenic variety, and scientists who valued

Fig. 8. The cliff fall at Beaumaris, as seen on January the 2nd 1990, with an ABC television camera crew.

Fig. 9. The bluffs south of Quiet Corner, Black Rock, were being undercut until an artificial beach was emplaced to protect them from erosion in 1984.

the cliffs for geological and geomorphological teaching and research. Surveys then showed that the erosion rate had been overstated, and that the risk to Beach Roads was remote, and the proposal was abandoned (Bird, Cullen and Rosengren 1973). Black Rock Point was listed as a Site of Scientific Interest by the coastal planners, who now endeavour to maintain such features. However, an important cliff exposure of Pleistocene sediments west of Point Henry, near Geelong, has vanished as the result of coastal engineering works.

In 1984 a new approach was initiated south of Quiet Corner, where beach depletion had resulted in undercutting of the bluff, threatening Beach Road. Instead of a boulder rampart, an artificial beach was emplaced to act as a protective feature and also improve the recreational resource (Bird 1990). This has been successful (Fig. 9), and a similar artificial beach is to be established in front of the eroding cliffs at Sandringham.

Where the risk of cliff falls has become high, it may be necessary to fence out sectors of cliff, as at Sandringham, to deter people from wandering into a hazardous area. Some councils, aware of the possibility of legal action, have placed warning signs near particularly dangerous cliff sectors. The question of responsibility needs to be resolved. We must surely accept that certain places, such as cliffs, quarries, waterfalls, rivers, and lakes are inherently dangerous: we cannot fence them all off, and too many warning signs are counterproductive. Cliffs are features of scenic and scientific value, and should not be destroyed by landscaping and engineering works. It should be acknowleged that they are hazardous, but people must be persuaded to avoid taking unnecessary risks with them, as with other elements of our natural environment.

Acknowledgements

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Lepilaena cylindrocarpa and *L. marina* at Swan Bay, Victoria.

S. Strother*

Introduction

Flowering plants which are restricted to life in marine conditions are known as seagrasses (Den Hartog 1970). The genus *Lepilaena* is often included with the seagrasses, tolerating conditions ranging from freshwater to hypersaline and includes species occurring in marine habitats (Robertson 1984). Robertson (1984) includes three species of *Lepilaena* likely to be present in marine and marine-associated (such as saltmarsh pools) situations in southern Australia, namely *L. preissii* (Lehm.) F. Muell., *L. cylindrocarpa* (Koernicke ex Walp.) Benth. and *L. marina* E.L. Robertson. The latter species was newly described in 1984 and is the subject of this article in relation to the hydrophyte flora of Swan Bay, near Queenscliff, Victoria.

The *Lepilaena* species present in Swan Bay, Victoria: past confusion

Earlier work carried out in Swan Bay (Kerr 1982) indicated that *Lepilaena cylindrocarpa* was present in the saltmarsh pools on the fringe of the bay and that a similar though not identical morphological form was present on the mudbanks growing in association with *Zostera muelleri* Irmisch ex Aschers.. Using the taxonomy available (Aston 1973), these forms were both reported as *Lepilaena cylindrocarpa.* This nomenclature was continued in a later paper (Denning *et al.* 1986). During late 1988 and early 1989, Mrs. E.L. Robertson was kind enough to identify specimens from Swan Bay, showing that *L. marina* is present on the mudbanks and *L. cylindrocarpa* in the saltmarsh pools.

The difference in the two species is apparent even by eye in that the mudbank species is a more robust plant than the saltmarsh-pool species. The differences in the fruits distinguish the two species in fertile material, as described in Robertson (1984). *Lepilaena preissii,* which we have not observed at Swan Bay (E. Kerr pers. comm.), should be easily distinguished from the other two species because it is consistently monoecious whereas the other two species are dioecious.

Recently Shepherd and Robertson (1989) reported that the specimen cited as *L. cylindrocarpa* collected from a mudflat in Swan Bay by King (reference cited) and preserved as a voucher specimen in the Melbourne University herbarium, is now classified as *L. marina.* This is consistent with the findings reported above.

Ecological aspects

Lepilaena cylindrocarpa appears to exist only in saltmarsh pools on the fringe of Swan Bay whereas *L. marina* coexists with *Z. muelleri* on the highest mudflats. The ecological differences associated with the two species may relate to their competitive ability. *Lepilaena cylindrocarpa* forms monospecific stands in the pools close to McDonald's jetty on the western side of Swan Bay. It is possible that some of the pools also include *Ruppia* species as the *Lepilaena/Ruppia* association is known from Westernport Bay (Vollebergh and Congdon 1986). *Lepilaena marina* by comparison competes with *Z. muelleri* for occupancy of the shallow mudbanks.

Vollebergh and Congdon (1986) in their study of *L. cylindrocarpa* growing in saltmarsh pools around Westernport Bay, showed that this species displayed a "winter annual" reproductive strategy, that is, seeds survive the hypersaline conditions as the pool dries out in summer and germinate in autumn or later in the year.

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Lepilaena cylindrocarpa was shown to germinate over a prolonged period under field conditions. This may ensure the maintenance of the population in this unpredictable environment. Unfortunately, little seems to be known about the ecology of *L. marina* but Robertson (1984) states that it is "probably annual". There is clearly a need for further study of this species and Swan Bay provides an ideal location for such study.

Conclusions

Lepilaena marina is the mudbank form of *Lepilaena* established on the mudbanks of Swan Bay and formerly referred to *L. cylindrocarpa. Lepilaena cylindrocarpa* in the strict sense (Robertson 1984) appears to be confined to pools in the saltmarsh fringe of Swan Bay, suggesting that some ecological differences may be associated with the different morphology of these two species. The range of occurrence of *L. marina* in Victoria still needs to be established.

Acknowledgements

The author is grateful to Dr Elizabeth Kerr whose initial mapping of the seagrasses of Swan Bay provided the background information for this paper, and also to Mrs Enid Robertson who kindly provided unequivocal identification of the *Lepilaena* specimens from Swan Bay.

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Bush-peas of Victoria – genus *Pultenaea* Sm. (Fabaceae) No. 24

A Key to *Pultenaea* species in Victoria and an index to previous articles

M.G. Corrick*

In the twelve year period 1976-1978 the Victorian Naturalist has published 23 contributions to this series in which 47 species of *Pultenaea* have been described and illustrated.

Taxonomic problems remain in several species, but it seems more useful to publish a key now rather than wait, possibly years, for problems to be resolved.

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Generic changes within the tribe Mirbeliae are foreshadowed (M.D. Crisp pers. comm.), and these will affect *Pultenaea*.

Some of the variations in recognized species have been dealt with by keying the same species in more than one place. One apparently un-named taxon appears as *P. sp.* followed by locality.

In using the key it should be remembered that many *Pultenaea* species are extremely variable and that several hybrid populations are known.

KEY TO PULTENAEA SPECIES IN VICTORIA

1. Style thick and hooked, 〈 twice as long as ovary; stipules up to 0.5 mm long, very inconspicuous, never fused behind the petiole (slender, wiry shrubs of wet heathlands) 2
   Style slender and gently curved, 〉 twice as long as ovary; stipules usually more than 0.5 mm long, often partly fused behind the petiole 3
2. Flowers up to 7 mm long; stems hairy with long, pale hairs ..... *P. paludosa*
   Flowers 8-11 mm long; stems glabrous (very young shoots may be slightly pubescent) ..... *P. subumbellata*
3. Leaves opposite or in whorls of three 4
   Leaves alternate (rarely sub-opposite in *P. dentata*) 6
4. Leaves opposite ..... *P. luehmannii*
   Leaves in whorls of three 5
5. Leaf blade linear; margin incurved; apex obtuse ..... *P. tenella*
   Leaf blade broadly rhomboidal; margin flat; apex conspicuously pungent ..... *P. cunninghamii*
6. Flowers terminal, 1 or 2 together at tips of shoots; flowers surrounded by persistent imbricate bracts; flowering shoots often short and spread along branches (new shoots arising below inflorescence) 7
   Flowers axillary or in a condensed head-like raceme of about (3-)6-12 flowers; bracts present or absent; if head-like inflorescence composed of 〈 5 flowers then bracts absent or deciduous (new terminal shoots arising from within inflorescence) 9
7. Leaf blade pungent, flat, lower surface with 3-5 parallel veins ..... *P. muelleri*
   Leaf blade blunt, tightly inrolled and grooved above, appearing terete, veins obscure 8

8. Leaf blade broadest above the middle, tip recurved, petiole absent or minute and < 1 mm long; stipules broadly triangular, length/width ratio up to 2:1. ..... *P. prostrata*
Leaf blade broadest at or below the middle, tip straight, petiole distinct 1-2 mm long; stipules narrowly triangular, length/width ratio > 3:1 ..... *P. prolifera*
9. Leaf blade broadly ovate to orbicular, 2-4 mm long, 1.5-4 mm wide with short, recurved, pungent apex (uncommon plants of western Victoria, except for an isolated eastern occurrence of *P. densifolia* near Bindi) 10
Leaf blade various, not as above, usually at least twice as long as wide; apex variable, pungent or blunt; if less than twice as long as wide then apex not pungent 11
10. Leaf blade glabrous, broadly ovate or broadly elliptic, 2-4 mm long, 1.5-3 mm wide; flowers sessile (plant of mallee areas in Big Desert and an isolated eastern occurrence near Bindi) ..... *P. densifolia*
Leaf blade hairy on underside, ± orbicular, 2-4 mm diameter; flowers on distinct pedicels up to 5 mm long (plant endemic on Mt. Byron in Black Range) ..... *P. patellifolia*
11. Margin of leaf blade recurved or revolute (leaves occasionally concave or 'V' shape in section), if margin flat then leaf darker on the upper surface 12
Margin of leaf blade incurved or involute, if margin flat then leaf darker on lower surface 25
12. Bracts absent, flowers one per leaf axil on pedicels usually much longer than leaves; usually prostrate, mat-forming plants ..... *P. pedunculata*
Bracts present; flowers forming a condensed raceme or head-like cluster, sessile or shortly pedunculate; habit various but not mat-forming 13
13. Bracts deciduous 14
Bracts persistent 22
14. Leaf apex pungent 15
Leaf apex blunt, but weak, usually recurved mucro may be present 16
15. Leaf blade cuneate to oblanceolate, terminating abruptly in a pungent mucro ..... *P. daphnoides*
Leaf blade narrowly eliptic to linear, tapering gradually to a pungent point ..... *P. benthamii*
16. Leaf blade broadest below the middle ..... *P. gunnii*
(widespread form)
Leaf blade broadest at or above the middle 17
17. Leaf blade widest at the middle, oblong, elliptic or emarginate 18
Leaf blade widest above the middle, cuneate, obovate or obcordate 21
18. Flowers 5-6 mm long; leaves erect, length usually >5 times width .... *P. retusa*
Flowers 7-10 mm long; leaves spreading, length usually < 4 times width 19
19. Leaf blade apex blunt, slightly indented, margin thin (on granite hills of N.E. Victoria) ..... *P. platyphylla*
Leaf blade apex with weak recurved point, margin thick 20
20. Upper surface of leaf blade rough with remains of tubercle based hairs; stipules dark brown, longer than petiole ..... *P. gunnii*
(Brisbane Range form)
Upper surface of leaf blade smooth, stipules light brown, usually not longer than petiole ..... *P. stricta*
(lowland plant of moist situations)

21. Leaf blade glabrous, both surfaces finely sprinkled with brown dots, upper surface usually much darker than lower (on dried specimens) ..... *P. retusa*
Leaf blade with upper surface scabrid, lower surface with loose, rusty hairs, or glabrous 22
22. Upper surface of leaf blade scabrid with tubercle based hairs, lower surface with loose, rusty hairs (leaf size and shape very variable) ..... *P. scabra*
Upper surface of leaf blade scabrid but not hairy, lower surface glabrous ..... Forms of *P. scabra* from Grampians including hybids with *P. benthamii*
23. Lower leaf surface with spreading hairs; leaf tip with long, fragile, glabrous mucro; stems with a mixture of short and long spreading hairs ..... *P. polifolia*
Lower leaf surface with appressed hairs; leaf tip pubescent, either with a short, recurved point, or tapering gradually into a long slender point; stem usually with appressed hairs 24
24. Flowers 7-8 mm long ..... *P. linophylla*
Flowers (9-)10-12 mm long 25
25. Stipules 4-7 mm long, about ⅓ length of leaf ..... *P. paleacea*
Stipules 1.5-2 mm long, up to ¼ length of leaf ..... *P. capitellata*
26. Ovary glabrous or with hairs only at the summit 27
Ovary pubescent to the base 33
27. Bracteoles trifid, divided at or above the middle; central lobe narrow, linear, outer lobes broad, brown and conspicuous 28
Bracteoles entire, or if trifid then divided below the middle with central lobe often leaf-like and outer lobes narrow and inconspicuous 29
28. Leaf apex with long, weak, recurved point; stipules 4-5 mm long, strongly recurved; lower stems leafless with prominent stipular scars; standard length = width c. 10 mm long x 10 mm wide ..... *P. sp.* (Splitters Range and Myrtleford)
Leaf apex blunt; stipules 2-3 mm long, not recurved, lower stems usually leafy, stipular scars not prominent, standard length > width c. 10 mm long x 7 mm wide ..... *P. subspicata*
29. Leaves tapering to a point, usually pungent, concave or 'V' shape in section and recurved from stem, venation not palmate (apparent on lower surface) ..... *P. procumbens*
Leaves blunt; venation not palmate 30
30. Leaves 1-4 (-5) mm x 0.5-3 mm, < twice as long as wide ..... *P. foliolosa*
Leaves 5-15 mm x 1-5 mm > twice as long as wide 31
31. Bracteoles ovate, shorter than calyx tube ..... *P. altissima*
Bracteoles narrowly triangular, longer than calyx tube 32
32. Leaves spreading; blade ± flat with incurved margin; flowers deep orange and brick red; stems and usually whole plant hairy (glabrous plants occur in Rushworth area) ..... *P. humilis*
Leaves ± erect, terete; flowers pure yellow, stems and usually whole plant glabrous (plants with hairy leaves occur in Kinglake area) ..... *P. weindorferi*
33. Leaf apex pungent 34
Leaf apex obtuse or with fragile bristle-like point (often deciduous with age) 38
34. Leaves with 5 prominent longitudinal veins on underside (endemic in Grampians) ..... *P. costata*
Leaves not obviously veined on underside, or with central vein prominent ..35

35. Bracteoles linear to narrow-triangular, seldom resinous 36
Bracteoles broadly ovate, highly resinous and shining 37
36. Bracteoles much longer than calyx tube, narrowly ovate with long, slender, acute tip; stipules conspicuous and almost obscuring the stem (bracteoles and stipules fringed with long hairs) ..... *P. acerosa*
Bracteoles usually shorter than calyx tube, narrowly ovate to ovate with short, acute tip; stipules narrow and not obscuring the stem ..... *P. juniperina*
37. Leaves terete; bracteoles about ½ the length of calyx tube (endemic in northern Grampians) ..... *P. williamsoniana*
Leaves ± flat with inrolled margin; bracteoles longer than calyx tube and enveloping it (on granite hills in N.E. Victoria) ..... *P. vrolandii*
38. Calyx tube glabrous; hairs, when present, confined to calyx lobes 39
Calyx tube and lobes hairy 40
39. Flowers 1-3 in a tight cluster at the tips of short lateral branches; stipules lanceolate 2-3 mm long, tapering to a slender point ..... *P. tenuifolia*
Flowers axillary, usually well spaced along branches; stipules boat shaped c.1 mm long (strongly aromatic, uncommon shrub of western and central Victoria) ..... *P. graveolens*
40. Stems glabrous or with appressed hairs 41
Stems with spreading hairs 45
41. Bracteoles trifid, (lateral lobes often obscure in *P. laxiflora*) 42
Bracteoles entire 43
42. Leaves widest at or below the middle, not clustered, tips straight, stems glabrous ..... *P. dentata*
Leaves widest above the middle, usually clustered, tips recurved, stems hairy ..... *P. laxiflora*
43. Bracteoles attached at base of calyx tube (small, weak alpine shrub) ..... *P. fasciculata*
Bracteoles attached at middle of calyx tube 44
44. Leaves conduplicate and recurved, 3-5 (-9) mm x 1-3 mm (rigid divaricate shrub of dry forests, often in auriferous areas) ..... *P. largiflorens*
Leaves + flat, not recurved, 6-8 mm x 2.5-3 mm (rare plant of Grampians, Victoria Range, probably extinct) ..... *P. maidenii*
45. Bracteoles variously 3-lobed 46
Bracteoles entire, often resinous 49
46. Lateral lobes of bracteoles conspicuous, brown and papery and as wide, or wider than centre lobe (uncommon plants of western Victoria) 47
Lateral lobes of bracteoles usually inconspicuous, pale and not wider than centre lobe, if wider than centre lobe then dark and resinous 48
47. Stipules pale, connate almost to the tips, persistent, overlapping and obscuring the stems. Leaves mucronate, rigid, glabrous except when very young ..... *P. vestita*
Stipules dark, connate only at the base and not obscuring the stem, leaves blunt with spreading hairs ..... *P. d'altonii*
48. Leaves + flat, margin incurved but upper surface visible ..... *P. hispidula*
Leaves tightly inrolled, appearing terete, grooved above, leaf blade usually gently upcurved ..... *P. mollis* (a form from Grampians and S.W. Victoria)
49. Flowers rose pink (shrub of higher parts of eastern Grampians) .. *P. subalpina*
Flowers yellow or orange 50

50. Leaves 5-9 mm long and 0.5-3 mm wide, flowers 8-10 mm long (a widespread and very variable shrub) ..... *P. hispidula*
Leaves 10-23 mm long and 0.5-2 mm wide, flowers 10-14 mm long 51
51. Flowers inconspicuous, overtopped and ± hidden by the leaves (uncommon plant restricted to coastal dunes and cliffs) ..... *P. canaliculata*
Flowers conspicuous, not hidden by the leaves 52
52. Leaves usually 〈 1 mm wide, margins tightly inrolled, upper surface rarely visible ..... *P. mollis* (widespread form)
Leaves 〉1 mm wide, margin inrolled but upper surface visible 53
53. Bracteoles 2.5-3.5 mm wide, longer than calyx tube and usually as long as whole calyx ..... *P. viscosa*
Bracteoles up to 2 mm wide and about as long as calyx tube ..... *P. mollis*
(some forms from southern Grampians and Portland)

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canaliculata F.Muell.	93: 250-252 (1976)
capitellata Sieber ex DC.	97: 217-221 (1980)
costata H.Williamson	95: 188-190 (1978)
cunninghamii (Benth.) H.Williamson	94: 112-114 (1977)
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pedunculata Hook.	94: 198-200 (1977)

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Communal roosting of the Bell Miner *Manorina melanophrys*, Meliphagidae

Aldo Poiani*

The Bell Miner (*Manorina melanophyrs*, Meliphagidae) is a co-operatively breeding honeyeater (Swainson 1970). Both adult and immature birds live in groups in which the breeders are assisted in their parental duties by one or more helpers-at-the-nest (Skutch 1961).

The social behaviour and the reproductive biology of the Bell Miner have been intensely studied during the last years (Smith and Robertson 1978, Clarke 1988). Nevertheless, there are still many aspects of the Bell Miner's social life which are not entirely understood.

Roosting is one of the behaviours we completely lack information about. It is known that roosting communally is a characteristic of several co-operative birds e.g. White-fronted Bee-eater *Merops bullockoides* (Hegner *et al.* 1982), Stripe-backed Wren *Campylorhynchus nucalis* (Zack and Rabenold 1989), Laughing Kookaburra *Dacelo novaguineae* (pers. obs.). Moreover, some authors have proposed that communal roosting has been a pre-condition favouring selection for helping behaviour in some species (Ligon *et al.* 1988, Glen and Perrins 1988).

Here I record some field observations on roosting in the Bell Miner.

On 27 June 1989 I was at the Gresswell Forest in Bundoora. At 17:00, while I was taking down a mist-net with the help of G. Paras, we observed a few Bell Miners starting to perch on a branch 5 m from us and about 2 m high. They initiated roosting without displaying to each other as they do, for instance, when performing a corroboree or communal gathering.

Three birds soon formed a "core" where they perched in a line touching each other's body without changing their position for the 25 minute period of observation. There were four other birds in the group. Once the core was formed, the other four birds started taking positions at the edge of the core with frequent changes of side. These four birds kept changing side for over 25 minutes giving the impression that they were competing for an "inner" place, a position between two birds. This was particularly clear when some bird tried to push itself (always unsuccessfully) between two birds already perched. Ultimately, at 17:25 they stopped swapping sides and formed a continuous line of seven birds.

I was also looking for roosting groups in the Sir Colin Mackenzie Zoological Park at Healesville in November and December 1989. Nevertheless, after searching in the understorey at night I could not find evidence of communal roosting. I did flush two roosting Bell Miners from the understorey, but both were roosting solitarily.

On 24 February 1990 I observed roosting behaviour at Healesville at sunset. Some of the birds seemed to roost in the same shrub, but they were not forming a roosting line as in the Gresswell Forest. Therefore, it is possible that roosting groups might be preferentially formed in winter.

Although the data set available is still too meagre to test any hypothesis, it is possible that roosting behaviour may change during the year since the costs and benefits of communal roosting may be different from season to season. For instance, in winter the birds may get benefits in terms of a better thermal insulation by means of roosting communally. In summer, the comparatively smaller benefits of increased thermal insulation may be outweighed by possible costs such as increased transmission of ecto-parasites or risk of predation.

In conclusion, I report here the first observation of communal roosting in the

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Bell Miner. A more detailed study on roosting behaviour will throw more light on the conditions in which communal roosting occurs. Also, it will enable us to determine which birds form the core and which ones form the edge of the roosting line.

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A note on Budgerigars in Hamilton

P. R. Bird*

Budgerigars *(Melopsittacus undulatus)* are well-known parrots of the inland which often migrate south to the higher rainfall areas. Flocks regularly appear in the little Desert National Park in early October and depart after the breeding season, usually in early March (National Parks Service, 1979). They are an occasional visitor to the Grampians area (McCann, 1982). The most southerly records of budgerigars in Victoria are at two points, just east and west of Hamilton (Emison *et al.* 1987).

On 9 January 1982 I first observed a budgerigar wild-type plumage of green and yellow in a River red gum *(Eucalyptus camaldulensis)* woodland on a 5 hectare block on the northern boundary of Hamilton in SW Victoria. Aviary escapees do occur at times near towns but this bird did not display the signs of a lost bird. I kept a record of later sightings and at intervals attempted to record numbers present:

22 November 1983
12 birds flew from the edge of the central drive.
27 November 1983
2 birds feeding on seed heads along the drive.
4 February 1986
1 bird in River red gums along the drive.
26 November 1986
3 birds feeding on grass heads along drive.
6 December 1987
4 birds on native grassland on SE fence.
10 December 1987
14 birds roosting in trees near SE fence.
15 December 1987
20 birds in trees and feeding in short grass in 'cow' paddock near SW fence.
22 December 1987
25 or more birds in the above general area.
23 December 1987
37 birds in the central drive area.
5 January 1988
13 birds on NE fence, near mown native grass.
14 January 1988
15 birds still feeding on the block.
27 January 1988
4 birds counted.

An unforgettable day was the spectacle of 37 feathered gems drifting from the trees, through shafts of afternoon sunlight, to alight on long stalks of Spear grass. The birds usually operated in small groups, feeding actively on the seed heads of grasses; Spear grass *(Stipa spp.)* in particular, but also Wallaby grass *(Danthonia spp.)* and they appeared also to forage among introduced species. The birds were not unduly concerned by a cautious approach within a few metres.

Approximately 40% of the 5 hectare property had been ungrazed since 1981 to encourage regeneration of native grasses, including Kangaroo grass *(Themeda triandra)* and Weeping grass *(Microlaena stipoides)*. Other portions were either slashed or burned (20%) or lightly grazed (40%) for fire control purposes. There were areas of Yorkshire Fog grass *(Holcus lanatus)* and Barley grass *(Hordeum sp.)*, and sparse Onion grass *(Romulea rosea)*, Silver grass *(Vulpia bromoides)*, Perennial ryegrass *(Lolium perenne)*, *Bromus spp.* and other introductions. Prior to 1981 the entire area had been heavily grazed by sheep but little fertilizer had been used. The recovery of Wallaby grass was spectacular after grazing was removed but there was a drastic reduction in this component, and a concomitant increase in Onion grass, on fuel reduction areas that were burned in summer. Frequent mowing also resulted in Onion grass dominance. Themeda was encouraged by annual mowing in early

* P.O. Box 180, Hamilton, Victoria, 3300.

summer, with the cutter set high to avoid crown damage, but no birds were seen feeding on this sparsely-seeded species.

It appears that the habitat had been sufficiently modified to suit ground-feeding birds. That was also evident by the large numbers of Red-rumped parrots (sometimes as many as 100 birds) and Eastern rosellas that congregated on the block to feed. Another factor was probably the presence of a rather dense (50 or more trees per hectare) population of River red gums of mixed age in the 4 ha of wooded area, with adequate access to grassland around, and water available from troughs, gardens or a dam. Neighbouring properties add another 5 or more hectares of trees, rather more sparsely spaced and with more improved pasture, and while the budgerigars did spend some time there (mainly in the trees), they obviously preferred the native pastures.

Since leaving that location in 1988 I have not been able to ascertain whether the birds have reappeared. Visits on one occasion each in the summers of 1989 and 1990 were fruitless, but my previous experience was that they did not spend all of their time during the months of Nov-Feb in that immediate area.

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A trip to Nooramunga with the Fauna Survey Group

Joe Leahy

The islands of the Nooramunga Coastal Park are forever being bullied into shape by the elements. Huge, hateful breakers batter the islands' beaches. Squalls surge through the arid heathlands of the area. Wildfires char plants and their roots, allowing the wind to whisk away the fragile dunes of the region.

Within this melee of natural forces some of Victoria's smallest and most timid mammals are believed to live. One of the rarest of these is the New Holland Mouse. The Fauna Survey group visited the area last summer in pursuit of the mouse and I joined them as a novice. The experience proved to be an adventure in both conservation and learning.

We arrived at McLoughlins Beach in South Gippsland amid a fanfare of howling winds. It was Boxing Day 1989. At 1 p.m. members of the Fauna Survey Group, a division of the Field Naturalists Club of Victoria, were to leave here for a week in the Nooramunga Coastal Park.

The former Secretary of the Fauna Survey Group, Mr Julian Grusovin, later said that this expedition was one of nine planned for the period between Easter 1989 and the end of 1990. The work was voluntary. Its aim was to discover exactly what animals were living in the park so that the Department of Conservation and Environment (DC&E) could formulate a management plan for the region. This data would be taken from sightings, diggings, scats, animal remains and the results of pitfall, Elliott and cage trapping.

Less officially, or at least in my mind, the aim was to find the rare New Holland Mouse. In Victoria the Fauna Survey Group was a sort of patron saint to this mini-marsupial.

According to Julian Grusovin, the first New Holland mice were found in the Hunter Valley Region in New South Wales in the middle of last century. However the Victorian New Hollanders eluded naturalists until 1970 when the Mammal Survey Group (now the Fauna Survey Group) discovered them in the Mornington Peninsula to the immediate south of Melbourne. Julian said that today the Victorian range of the mouse is believed to be from Anglesea in south-western Victoria to Reeves Beach on the eastern fringe of the Nooramunga.

For habitat the New Holland Mouse prefers recently burnt heath. The Nooramunga park consists mostly of islands making this requirement a problem for the survival of these rodents. If an island is not burnt for several years, for instance, a colony of New Hollanders living there will be without suitable habitat. Unlike their counterparts on the mainland they will be unable to move to a better area.

What exotic features make this mouse stand out from its colleagues? None. In fact, if you saw them foraging in the garden you would probably rush to set the common mouse trap for them, rather than try to catch one live in an Elliott trap. So if ever you are in doubt check the tail of your captive. If it is a New Holland Mouse it should be dark on top and light on the bottom. To be extra sure examine the offender's teeth, the New Holland Mouse does not suffer from overbite like the introduced species and therefore is without notches on the inside of its incisors.

However the mouse was largely my fad – the group had much broader interests. On previous expeditions to the Nooramunga region they had recorded the rare Swamp Antechinus (a marsupial carnivore), the Eastern Pigmy Possum, bats, water rats, wombats, kangaroos, koala bones, echidnas, the Banjo Frog, the Jackie Dragon, some snakes and several varieties of skink.

Sitting in the car at windy McLoughlins Beach I knew little of the past activities of the group I was to spend the week with. All I knew was that they were out to catch New Holland Mouse.

My association with the Fauna Survey Group began in early December 1989 when a friend of mine, a second year ecology student at La Trobe University, invited me to a meeting to be held that night at the Astronomer's Residence in the botanical Gardens, South Yarra.

Malcolm Turner, a prominent member of the group and a biologist with the DC&E, had told her that membership with the Fauna Survey team could help her career. I attended to give her moral support.

The air was hot and rich with pollen in the Botanical Gardens that night. As we trekked through the open parklands yuppy cyclists whizzed by in flurries of fluorescent limbs and whirling wheels.

It was only with difficulty that we eventually found the stately Victorian residence of the Astronomer – we had been searching for a white dome-shaped shed with a telescope sticking out of it.

When the Fauna Survey Group were all seated to begin the meeting I surveyed them. I suppose I was expecting to see the stereotype field nats of old; on the one hand the Crosby-Morrison, bushman-type naturalists, on the other the English country gentleman-type naturalists who long ago exchanged their shotguns for binoculars and picnic baskets.

The people before me, however, looked more like the congregation of a Catholic church. A distinguished old lady occupied the front seat. However to my ignorant eyes she seemed as though she would be more at home judging poodles at the Royal Dog Show than scratching in the bush for the scats of marsupial rodents.

Behind her was an elderly gentleman whose name I later learnt was Tom Sault, a long standing member of the group. More than any other present Tom embodied the bushman-naturalist image. However he later told me that he rarely sacrificed life's common comforts while on camp. He was known for pulling a little campervan on every trip and cooking such wonderful meals in it that it became known as "Tom's Restaurant".

There was a core of young people in the room who all looked as though they had done some time at university. They had that intangible feeling of leisure about them that three or four years of campus life installs in people.

The tall, blonde tradesman Russell Thompson was also present. Returning from the bush on one occasion I showed Russell a slender bone I thought came from a horse. Without lifting his eyes from the curling steam of the cup of tea he was drinking, Russell amiably said, "That's a swan's thigh bone".

My friend's contact, Malcolm Turner, was to provide the main attraction of the meeting – a talk and slides about his recent adventures which included a trip to Queensland. Malcolm gave a sly grin as he began his talk, as if to say, "Look how much fun I've been having". Physically he looked as though he was still in Queensland. While the rest of us had perhaps shed one or two winter jumpers Malcolm arrived wearing shorts and T-shirt.

As Malcolm showed us his slides the room took on a warm and homely feeling. I felt at ease with the group as we peered eagerly at the curios of nature that Malcolm had captured in his slides; things like turtle's eggs and the great boomerang tails of Southern Right Whales which he had photographed in the cold sea near Warrnambool.

Looking around at the naturalists present, their faces illuminated by the slides of northern Queensland, I reflected that each face was a slide itself, showing a keen interest in nature – and occasional disgust at Malcolm's habit of making weak puns.

Malcolm flicked the slide machine and a monster-faced Moray Eel swivelled into view. The eel's head was sticking out of its coral lair and was cupped in the hand

of a scuba-diver – Malcolm. As Mal explained his relationship with the eel, the scene took on the dreamy quality of a distant friendship hatched in some far-off polyp grove.

For me Malcolm exuded the love for nature that all keen naturalists share. When such people discuss the natural world it is as though they are talking of an old friend.

I first encountered this relationship between the naturalist and the subject of his work as a young boy watching Harry Butler on TV. You could say that I was brought up "In the Wild with Harry Butler" because the show gave me many of my first insights into the bush.

Harry's program left me with two strong needs; a desire to understand the natural world and an urge to preserve it. As the meeting concluded I felt that this group could become the outlet for these needs that I had been waiting for.

Despite this it was still with some reluctance that I put my name down for the forthcoming trip to St Margaret's Island. Long camps with family and friends had taught me to be suspicious of spending time at such close quarters with people I had newly met. However the possibility of finding the New Holland Mouse lured me and I ended up signing to go.

Nothing went well on the first day of the St Margaret Island camp. We carted our luggage the one hundred metres or so to the end of the McLoughlin's Beach pier under guerilla attack from squall-force gusts of wind.

It was then a matter of waiting for the DC&E launch that had been arranged to drop us at the island. However the launch only stayed long enough for its captain to tell us that one of its motors was out and that they were not going to risk a trip to the island in those conditions.

We reloaded our cars and drove to the McLoughlin's Beach jetty. This long footbridge crosses a muddy backwater separating part of the Ninety Mile Beach known as Reeves Beach from the mainland.

We camped the next few nights in a dell behind Reeves Beach, an area, according to Malcolm, where New Holland Mouse had been found. When the winds eventually died away we emerged from the heath, spread our gear across the middle of the jetty and again waited for the fateful DC&E launch. Standing and sprawling forlornly about the breezy jetty we must have appeared to the locals like a group of refugees.

However I was learning too much to worry about the occasional hardship. I had always enjoyed camping and considered myself a lover of the bush but a week with the Fauna Survey Group soon showed me how little I knew of my beloved.

The group had immense collective knowledge. There were science graduates like Eva Demetriadus, Sarah Brown, Karen Lester and Malcolm Turner on the trip. Jenny Chappill had a Ph.D in Eucalypt Taxonomy. Russell Thompson was, of course, great with bones and Wendy Clarke was partial to spiders. Whatever the field there were people in the team who knew something about it.

As one of several novices in the group I was made to feel welcome. When an animal was caught the experienced people were happy to explain the creature to us and answer our questions.

Without complaint everyone who felt the need set about the often difficult tasks before them. There were pitfall lines to be filled in and new ones to be dug. There were traps to be set, 10 to a person, and bat mist nets to be checked at regular intervals before bed. And of course there were morning and night swims to be had on the island's pristine beaches (that is, when we did get to the island).

At night Malcolm took us spotlighting into a grove thick with spiny Grass-trees and saw-leafed Banksia. We were looking for pigmy possums. However our quest for these animals ran like an episode of "Scooby Doo", the children's cartoon of the seventies. Whenever Malcolm stopped those in the darker back ranks would keep

walking and the result was a multi-person pile-up. If someone thought they had seen something ten torches would instantly spot the area of the sighting, accompanied by a hubbub of excited voices.

However throughout it all the New Holland Mouse still eluded us. On our second last night at St Margaret's, Malcolm, myself, my ecologist friend and some others boated and waded from St Margaret's to nearby Hummock Island. We went to the island to catch bats but I knew that Malcolm had set some ground traps there previously. These traps were my last hope of seeing the party-pooping mouse on this trip.

We got the nets up after dusk and relaxed beside a small fire. The word must have been out among the bats and therefore we did not catch any. The next day we hoisted our ridiculously over-stocked packs and made our way through dense T-tree to the beach. There was one more task we had to do before we left the Nooramunga Coastal Park, check the traps.

The cage traps produced one or two Swamp Rats. The only traps that had not been checked were the pitfall lines. The first pitfall yielded a tiny Swamp Rat, huddled like a furry egg in the cover provided in the trap. The second contained a House Centipede. The third contained a little, big-eared . . . mouse!

Malcolm lent over and picked the rodent up, its small, shivering body dwarfed by his hand. Turning to me he said, "You may not want to watch this . . ." My hopes of seeing the New Holland Mouse were dashed. The victim was a common house mouse, vermin, and had to be destroyed.

Tape Review
Calls of Victorian frogs

Recorded and narrated by Murray Littlejohn
Compiled and mixed by Duncan Smith
Department of Zoology, University of Melbourne

Most naturalists are familiar with the calls of a number of common birds, and (often subconsciously) use the calls as a means of identification. The calls of some of our noisier mammals, such as the bellow of the Koala and the indescribable rattle of the Brush-tailed Possum, are equally well known. But when it comes to frogs, the whistles, trills, barks, growls, squelches and plonks are little more than background noise for most people. The frogs perceive it all differently of course. These sounds are their advertisement calls, which are given only by males, allowing females to distinguish and locate males of their own species, and discouraging approaches by rival males.

With the handy acoustic guide produced by Littlejohn and Smith, anyone can learn to eavesdrop on these anuran nightclubs and confidently identify the species responsible for each call. The tape contains 35 recordings, covering all but one of the 34 species likely to be found in Victoria, plus two extra recordings for two species, that show marked geographical variation. A good recording of the missing species, the rare and threatened Spotted Tree Frog, *Litoria spenceri*, was not obtained until after this tape had been compiled. The recordings are of a generally high standard. All were recorded in the field, and have a pleasing natural quality by virtue of the hubbub created by other frogs and sometimes crickets nearby. If you listen closely you may also detect human voices, and even a distant train.

The cover notes list the scientific and suggested common names of each species, their distribution within eight Victorian biotic provinces and the months in which they call. There is also a short discussion of the biological function of advertisement calls.

The commentary, by Murray Littlejohn, introduces the species featured in each selection by common and scientific name, and lists the species in the background. Disappointingly, the commentary gives no description of the call. Although the background calls rarely intrude, on some selections (e.g. the Common Spadefoot Toad, *Neobatrachus sudelli*) there is room for confusion which could be avoided if the distinctive features of the call were given. Littlejohn wisely avoided giving onomatopoeic descriptions, which might have become, as in the analogous case of bird calls, far more impressive for the feats of imagination needed to interpret them than they are for their benefits to field recognition. Which bird goes 'wheat wheat wheat WHITTLE', for example? However, a brief description can be useful when it acts mnemonically, allowing the listener to recall the name of a species even when the tape has been left at home. The narration goes some of the way towards this for a couple of species, telling us for example that the call of the Victorian Smooth Froglet, *Geocrinea victoriana*, is given in two parts, but not adding that it is a drawn-out creaking sound followed by a series of short pips, or that the closely-related and sometimes sympatric Southern Smooth Toadlet, *G. laevis*, leaves off the pipping sequence. Why not mention that the northern call race of the Spotted Marsh Frog, *Limnodynastes tasmaniensis*, sounds like a machine-gun, that a chorus of Pobblebonk Frogs, *Limnodynastes dumerili*, give a good imitation of an arpeggio on a banjo, or that Peron's Tree Frog, *Litoria peroni*, produces a 'maniacal cackle'.

This criticism aside, the tape is a valuable aid to the fledgling (or metamorphling) frogger, as well as to the more experienced listener in an unfamiliar area. At present it is available only from the Department of Zoology, University of Melbourne. At a price of $10.00 it is excellent value. Play it in the car on the way to your favourite pond.

Graeme Coulson
Institute of Education
University of Melbourne

Prophetic words

"But perhaps the most interesting of the younger associations is that of the Field Naturalists, whose main delight it is to go abroad in company, to visit such districts as are likely to yield a harvest to the devotees of the hammer, of the net, or of the dredge; to the collector of plants or the sticker of insects. Their most notable ramble was that in which they were landed from a steamer on King's Island, and overhauled that isolated region to carry back their various trophies of fauna, or flora, or mineralogy. The monthly evening meeting of these Field Naturalists is full of interest; each is so zealous about his own department, and all contribute so largely to the store of exhibits that crowd the tables. From these amateur enthusiasts there ought to spring the material for excellent research in future years."

From Victoria and its metropolis: past and present. 1888.

F.N.C.V. Library report 1989-90

Our library is still in storage, with consequent curtailment of service to members. Periodicals have been available at General meetings, together with some new books. Thirty titles have been added to stock this year, including *Flora of Australia V.3; Fauna of Australia V.1A* and *1B; Zoological catalogue of Australia V.6* and *V.7;* D.L. Jones: *Native orchids of Australia;* Mackness: *Prehistoric Australia.* We acknowledge the receipt of a number of review copies from publishers, amongst which were three titles from the Australian Natural History series, published by New South Wales University Press: Triggs: *The wombat;* Reilly: *The lyrebird* and New: *Associations between insects and plants.*

The main beneficiaries from the library's resources have been people seeking information about early members of the Club, most notably Charles French, whose great-great-grandson, Michael Jennings, contacted us. Charles French, who was the Government Entomologist, is buried in Cheltenham Old Cemetery, in an unmarked grave. Michael intends to remedy this, with a plaque indicating his great-great-grandfather's achievements, and Council has requested that the fact that Charles French was the founder of the F.N.C.V. should also be included.

Other enquires concerned Daniel Sullivan, a schoolteacher at Moyston in the Grampians from 1868-1894, who was elected to the Club in 1881; and James File Bailey (not John, as stated in his obituary notice in the *Victorian Naturalist V.1.* 1884), whose interests were palaeontology and conchology, and who met an untimely death from pneumonia after being caught by the tide at Frankston while in the pursuit of his hobby. He was Club Librarian in 1883-84. We are grateful to Mrs Loris Hornbuckle for a photograph of her grandfather.

Film Australia sought information about the removal of koalas from Quail Island in 1943 for a documentary by Paul Scott, *Koalas – the Bear Facts,* to be shown on TV this year.

The bulk of the Club's archives and historical material up to 1890 has now been listed. The photograpic collection, ranging from albums to individual photographs, now contains 80 listed items. Dr J.H. Ross has agreed to make available to the Club space in the Herbarium library for a filing cabinet in which to store this material. We appreciate his co-operation in this matter, and also that of the librarian, Helen Cohn. Plans for rehousing the library are still very much in the melting pot, but we look forward to a satisfactory resolution of this problem during the coming year.

I would like to thank Olive O'Hagan for continuing under difficulties to record the arrival of periodicals.

Sheila Houghton
Hon. Librarian

Notice

The Montmorency Field Naturalists Club meets on the second Friday of each month, 8 pm at the Salvation Army Hall, Flodden Way, Briar Hill (Melway 21 C2).

Visitors welcome.

Enquiries: Elaine Braby, ph. 439 9015.

Field Naturalists Club of Victoria

In which is incorporated the Microscopical Society of Victoria

Established 1880

Registered Office: FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron
His Excellency, The Rev Dr John Davis McCaughey, The Governor of Victoria.

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MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1990

Metropolitan Members (03 area code)	$27
Joint Metropolitan	$30
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FNCV DIARY

General Meetings

Held on the second Monday of the month (except for public holidays), 8.00 p.m. at the National Herbarium Hall, corner of Birdwood Avenue and Dallas Brooks Drive, South Yarra. Meetings include a talk by a guest speaker. All members of the public are welcome.

Monday, 8th October
Gannets of the oceans.
Mary Doery.

Monday, 12th November
Reproduction in Echinoderms.
Mark O'Loughlin.

SPECIAL NOTICE:
Monday, 10th December
NOTE CHANGE OF MEETING PLACE OF GENERAL MEETING.
"Presentation of Natural History Medallion" to Mrs Ellen McCulloch will be held at the Royal Society Hall at 8.00 pm. (Corner of Victoria and Exhibition Sts).

FNCV Excursions

For further information on excursions contact Dorothy Mahler (850 9379 A.H.).

29th September-5th October
Gypsy Point. Contact Marie Allender if you are interested (527 2749).

Sunday 7th October
Cranbourne annexe of the Botanical Gardens. Private transport.
Ring Pat Carolan (592 5552) if you require a lift.

Sunday 4th November
Courtney's Road Lysterfield by car. Melways 84 D7. Cars meet at reserve at 10.30 a.m.

Sunday 2nd December
Brisbane Ranges. Bus leaves Batman Avenue 9.30 a.m. Leader: Peter Kelly, on beetles. Cost $18.50.

Group Activities

Botany Group

Group Meetings (second Thursday)

Thursday 13th September
Victoria's Rainforests. David Cameron.

Thursday 11th October
Oranges and Boronias. The family Rutaceae. Hilary Weatherhead.

Thursday 8th November
Botanical ramblings in France.
Mary Doery.

Excursions

Saturday 27th October
Rare grassland plants. Establishment program at Skipton. Leader: Neville Scarlett.

Sunday 28th October
FNCV Cosslick Reserve and Paddy's Range. Contact M. Potter (889 2779).

Saturday 24th November
Hotchkins Ridge Flora Reserve, Croydon North. Leader: Cecily Falkingham.

Microscopial Group

Group Meetings (Third Wednesday)

Wednesday 17th October
The Scanning Electron Microscope.
Christine Ashburner.

Wednesday, 21st November
The video camera and the microscope.
Taken by Gary Richardson.

The Victorian Naturalist

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Editors: Tim Offor and Robyn Watson.

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Cover photo: The South Serra Range and Isolate Spur viewed from Mt William. (See the article on Major Mitchell's ascent on p. 128).

What future for the sandy heaths of Wilson's Promontory?

Tim Offor*

The heath communities of Wilson's Promontory are disappearing. Where once there were diverse heath floras there are now, in many places, depauperate closed scrubs of *Kunzea ambigua* (White Kunzea) and *Leptospermum laevigatum* (Coast Tea-tree). Where heath remains it is often old and senescent, with dead or dying *Allocasurarina pusilla* (Dwarf She-oak) and areas of bare ground.

The sandy heath communities are generally low growing (< 1m) and are dominated by *Allocasuarina pusilla* (Dwarf She-oak) and *Leptospermum myrsinoides* (Heath Tea-tree). Other common shrubs of the heath include *Banksia marginata* (Silver Banksia), *Hakea sericea* (Bushy Needlewood), *Epacris impressa* (Common Heath), *Isopogon ceratophyllus* (Horny Cone-bush) and *Correa reflexa* (Common Correa). The heath communities share many species in common with the low open forest communities into which they often grade, but they lack the eucalypt canopy of the forests.

As long as 40 years ago scientists noticed that the sandy coastal heaths of Wilson's Promontory, at the southern most tip of Victoria, were diminishing. *Leptospermum laevigatum* was invading the heaths from the coastal dunes to seaward. At the same time *Kunzea ambigua* was invading from nearby hillsides, moving from the dry forests of the rocky slopes into the heaths below. Slowly the heaths were disappearing beneath dense *Kunzea* and *Leptospermum* scrubs.

There have long been debates about whether or not the invasion of the heath by *K. ambigua* and *L. laevigatum* is a 'natural' or a human influenced process. As a corollary to this there has been debate on whether action should be taken to intervene and try to arrest and reverse the invasion process or whether nature should be left to take its course. In the meantime the invasion of the heaths has continued.

A great advantage that both *Leptospermum laevigatum* and *Kunzea ambigua* have over the heath species is the height to which they can grow on the sandy coastal soils. In a 0.5-1.0 m high heath, *K. ambigua* is able to grow to 2.0-2.5 m (Judd 1990). *L. laevigatum* is able to grow even taller on these sandy soils. Such a height advantage means that the heath species are easily overtopped by *K. ambigua* and *L. laevigatum* which often form a dense canopy, greatly reducing the amount of light reaching the shorter statured heath species. Sometimes it is possible to find a spindly *Allocasuarina pusilla* amongst the *Kunzea* thicket, a struggling survivor from the invaded heath community.

Since the decline of the heathlands has generally been a gradual process, people are often unaware just how much the vegetation of Wilson's Promontory has changed over the last few decades. Many people are surprised to learn that much of the dense *Leptospermum laevigatum* scrub surrounding Tidal River camping ground was once low heath. The only reminders are a few scattered heath plants on sunny banks where the ground has been disturbed and the dense *L. laevigatum* overstorey removed. The increased light, warmth and moisture has stimulated the germination of seeds which have remained dormant in the soil for decades.

The response of the heath community to fire

Dr. Terry Judd of the University of Melbourne has been researching the ecology of *Kunzea ambigua* and *Leptospermum laevigatum* for the past six years. "Both

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Kunzea ambigua and *Leptospermum laevigatum* are readily killed by fire. In the absence of fire both species have the ability to invade undisturbed plant communities, often forming thick scrubs which contain very few other plant species". So it seems that it is fire that holds the key to the state of the heathlands at Wilson's Promontory.

Fire is an integral part of Australian heath communities (Specht 1979). The high levels of volatile oils contained in the foliage of the dominant species renders them highly flammable. As a result the plants of Australian heathlands are well adapted to fire. Some species such as *Banksia marginata* and *Hakea nodosa* are bradysporous, that is they have their seed protected by woody fruit so that even though the plant may be killed by fire, the seed will survive to germinate, grow and produce a new generation of plants. Other species are able to survive a fire by possessing an underground source of buds in bulbs, rhizomes or lignotubers (synonymous with the 'mallee root' of the mallee eucalypts). The destruction of the above ground parts of the plant triggers the growth of the dormant buds and the plants rapidly regenerate.

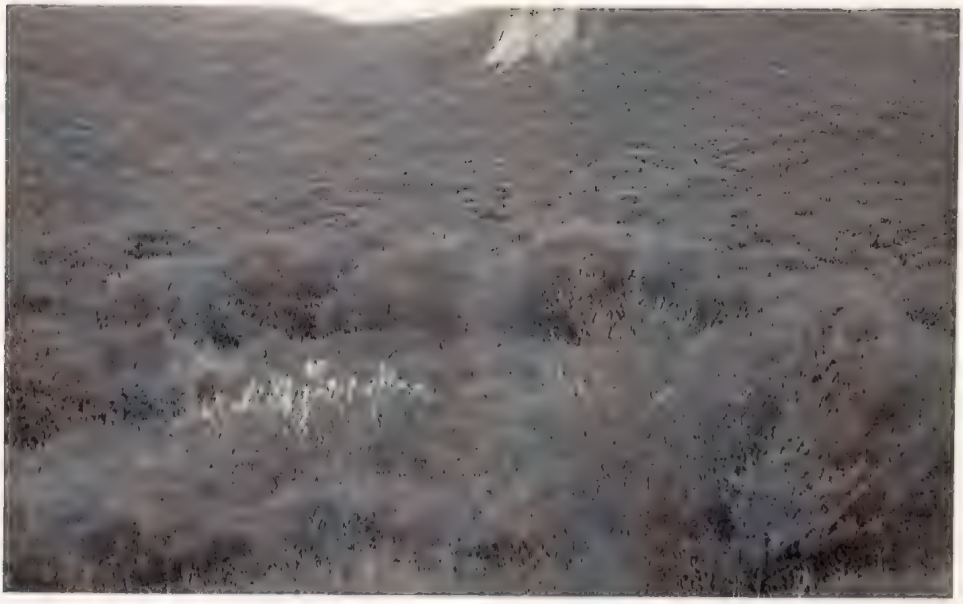
In the years immediately following a fire, the diversity of plant species in a heathland will increase. Posamentier *et al.* (1981) found that the number of species in a coastal heath at Nadgee Nature Reserve, N.S.W. reached a maximum 4 years after a fire, after which it slowly declined. As the heathland ages some species will slowly disappear from the heath, represented only by their dormant seeds in the soil "seed bank". Dominant species such as *Allocasuarina pusilla* and *Leptospermum myrsinoides* senesce and gaps begin to open up in what was previously a dense shrub layer. So it seems that fire is an important factor for maintaining high species diversity in heath communities.

Prior to European settlement, Wilson's Promontory had long been inhabited by Aboriginal tribes. The many shell middens along the coast are reminders of their presence in the area. We cannot be certain of the fire regime prior to European settlement, but we do know that Aborigines used fire to drive game, clear undergrowth and produce new growth to attract game (Recher and Christensen 1981). It is therefore probable that fire was a common feature in the plant communities at Wilson's Promontory during this time.

It may take 4 years or more following a fire for the fuel load in a heathland to build up enough to carry another fire (Specht, Rayson and Jackman 1958) so it is unlikely that the heaths were burnt more often that at 4 to 5 year intervals. The fire control measures used in recent times by Government authorities to protect Wilson's Promontory from wildfires have undoubtedly reduced the frequency of fires. Many of the heaths have not been burnt for 30-40 years, during which time the number of species present would have markedly decreased. Specht *et al.* (1958) found that 20 years following a fire, the number of species present in a South Australian sandy heath had decreased from a maximum of 36 species to 20 species. They predicted that probably only 10 of the original 36 would persist after 50 years.

Some scientists who have studied the heaths of Wilson's Promontory have proposed that it was frequent fires that kept *Kunzea ambigua* and *Leptospermum laevigatum* out of these heathlands (D.H. Ashton pers. comm; Burrel 1969; Judd 1990). There is some evidence for this occuring in heaths at Nadgee, N.S.W. When these heaths were protected from fire they became overgrown by shrubs and were invaded by eucalypts (Recher and Christensen 1981).

Both *L. laevigatum* and *K. ambigua* produce huge quantities of seed with up to 10 000 seeds falling on 1 m^2 of ground in one year (Judd 1990). *Leptospermum laevigatum* has woody capsules that protect the seed from the intense heat of



Kunzea ambigua and *Leptospermum laevigatum* invading heathland behind Squeaky Beach at Wilson's Promontory. The *Kunzea* is in the foreground (*tall shrub, right*) and dominates the slopes in the background. A row of *L. laevigatum* is in the middle distance.

a fire. Following the fire the valves of the capsules open and masses of fine seeds are released. The seed of *Kunzea ambigua* accumulates in the soil in the absence of fire and great numbers of seedlings can germinate following fire. It is also possible that the fleshly capusles of *K. ambigua* would protect at least some of the seeds from a fire of moderate intensity (Judd 1990). It is the dependence of *L. laevigatum* and *K. ambigua* on regeneration from seed that might be exploited for controlling their presence in the heath community.

Research and management of heathlands

It is only in recent times that fire has been used as a management tool for manipulating species composition of heathlands to fulfill conservation objectives. A collaborative research project between the Botany Department of the University of Melbourne and the Department of Conservation and Environment is currently investigating the use of fire to eradicate *Kunzea ambigua* and *Leptospermum laevigatum* from the coastal heathlands of Wilson's Promontory. The objectives of the research project are to study the effect of repeated burning and season of burn on *K. ambigua* and *L. laevigatum* presence in the heathlands.

An area of severely invaded heathland between Picnic Bay and Squeaky Beach has been divided up into five sections for the study. The flora of each section has been thoroughly surveyed by the 2nd year Ecology students prior to any burning taking place. The Fauna Survey Group of the Field Naturalists Club of Victoria will survey the fauna of each section prior to burning and for many years after to determine the effect of the fires on the fauna.

The first fire is planned for spring 1990 when two sections will be burnt. The second will be in autumn when two more will be burnt. One section is being left unburnt as a control. It is expected that there will be massive regeneration of

K. ambigua and *L. laevigatum* following the fires. In 3-5 years time one spring and one autumn burnt section will be burnt a second time. The timing of these second burns is very important since they must occur before *K. ambigua* and *L. laevigatum* have reached reproductive maturity and carry viable seed.

It may take years before the results of this research can be incorporated into management strategies for the coastal heaths. There are many questions to be answered. Will there be enough fuel for a burn within the required 3-5 years? Will two fires be sufficient to eradicate *K. ambigua* from the heath or will its soil seed store produce another crop of seedlings after the second fire? What other seed dependent species will be lost as a result of the double burning? Can the existing *K. ambigua* and *L. laevigatum* scrubs be returned to heathland? One thing, however, is for certain. If nothing is done to arrest the invasion, the heaths of Wilson's Promontory will continue to disappear beneath dense scrubs. A sad fate for a fascinating part of our natural landscape.

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First record of an Australian Sea Lion on the eastern Australian coast

W. N. Fulton*

The Australian Sea Lion

The Australian Sea Lion (*Neophoca cinerea*) is one of the world's rarest sea lions, with a population estimated at 3,000 to 5,000 (King 1983).

Neophoca cinerea is presently found only in Australian waters, from Houtman Abrolhos in Western Australia to Robe in the south east of South Australia, as shown in Fig. 1 (Walker and Ling 1981; Ling, personal communication 1990). Additionally, it should be noted, there are reports of old males being seen as far east as Portland in Victoria. The species breeds on offshore islands, in a slightly more restricted range. A skull was collected from Cape Barren Island in the Furneaux Group in Bass Strait in 1973, however it was quite old and may have lain on the beach for many years. In 1798 Matthew Flinders noted sea lions on several small islands of this group (Marlow and King 1974).

Birdie Beach Sighting

At about 10 a.m. on 22nd December, 1989 a seal, 2.24m in length, hauled out on the northern end of Birdie Beach (33°13'S, 151°35'E) in the Munmorah State Recreation Area, between Sydney and Newcastle, New South Wales. It was later identified from photographs as a male *Neophoca cinerea*.

Subsequent enquiries to a number of museums, and to the National Parks and Wildlife Service and other recognised authorities, reveal no known prior sighting of *N. cinerea* on the eastern coast of Australia.

The National Parks and Wildlife Service, with the assistance of volunteers from ORRCA (Organisation for the Rescue and Research of Cetaceans in Australia), cordoned off the area to minimise disturbance to the animal.

The seal had three fresh-looking (but somewhat infected) oval-shaped wounds on its left ventral surface, consistent with bites inflicted by the Cookie-cutter Shark (*Isistius brasiliensis*), and gave every appearance of exhaustion. For several days its only movements were progressively up the beach to avoid being lapped by waves, and down again with the tide to cooler sand. There was little reaction when we approached, or even when we once touched its tail.

The teeth were yellowed, chipped and worn, suggestive of an old animal. Notwithstanding its exhausted state, the seal appeared to have excellent condition, as can be seen from the photograph (Fig. 2).

We sprayed its wounds several times a day with an aerosol of Chloromide antiseptic, and observed an apparent lessening in the infection. Apart from that, we disturbed it as little as possible.

Fig. 1. Present-day range of *Neophoca cinerea* (after Walker and Ling 1981).

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Fig. 2. The Australian Sea Lion at Birdie Beach.

On Christmas Day we saw some signs of improvement. The seal wriggled on its back and then moved towards the sea, entering the water momentarily to let a wave wash over it. That evening at 9.30 p.m. it left the beach.

As locals had reported the animal was heading north before it came ashore, we searched to the north the next day, and found it in a sheltered cove with a pebble beach, about 1 km away. It was resting on the beach, swimming, and diving in turn, giving every appearance of recovery. Two days later, an unconfirmed report had it another 5 km north, at Catherine Hill Bay, and we have not heard of it since.

The animal was not tagged or marked. It may be an aid to subsequent identification that the fifth digit of the left hind-flipper is truncated, flush with the webbing.

On 11th March, 1990 a second, and different, male *Neophoca cinerea*, 2.30m in length, was photographed by the author while hauled out for three days on a jetty in Wollongong Harbour, just south of Sydney, following heavy seas. Fishermen reported having seen two seals in the harbour just previously.

Acknowledgements

The assistance of Ed Lonnon (Taronga Zoo) and Linda Gibson (Australian Museum) in identifying the animal is gratefully acknowledged. Dr. J. K. Ling (South Australian Museum), Professor J. D. Ovington (ANPWS), and Judith E. King kindly examined the photographs and commented on the known range of the species.

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Examination of a gastropod radula

Ian D. Endersby*

Introduction

Differentiation between the aquatic snails *Glyptophysa gibbosa* (Gould) and *Physa acuta* Drapanaud in Victoria requires an examination of the radula (Smith and Kershaw 1979) for certainty. Smith and Kershaw (1979) recommend that specimens be drowned with menthol as a relaxant and that the buccal mass be macerated in sodium hydroxide to extract the radula for microscopic viewing. Neither of these chemicals is readily available in most households and so an alternative method of preparation would be useful.

Small snails introduced into a garden pond with some samples of an aquatic liverwort were found difficult to identify from the twisted columella character of Smith and Kershaw's (1979) key. Based on former success on extracting a chiton radula the following method was used to identify the species. It may also prove to be useful on those occasions when the standard methods cannot be used.

Method

1. The snail was killed with boiling water and the animal extracted from its shell with jeweller's forceps.
2. Again using the jeweller's forceps, the "foot" was separated from the body and placed in a watchglass.
3. Household bleach containing sodium hypochlorite (White King in this instance) was used to dissolve the soft parts. For this small specimen (2 x 1 mm of foot) half an hour was sufficient for compete dissolution.
4. With the watchglass placed on a black background under a 20x binocular dissecting microscope, the transparent radula could be located and transferred to a drop of water on a glass slide.
5. A glass coverslip was placed on the water drop and this temporary mount examined at 40x and 100x under a compound microscope with diaphragm almost closed.

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Discussion

The radula was strongly contorted but sufficient detail of its bifurcated posterior end was visible to confirm the species as *Glyptophysa gibbosa*.

It seemed possible that the killing of the animal in boiling water, rather than the conventional relaxation methods, lead to the distortion of the radula. While this is unacceptable for taxonomic or curatorial purposes, in the absence of the correct chemicals it might suit the needs of a naturalist wanting a quick species confirmation. Repeating the experiment, however, produces an undistorted radula. On the first occasion it is likely that the distortion occurred when the radula was flattened during the preparation of the water mount.

To demonstrate that this method could have a wider application than the separation of the two species mentioned previously, it was used to extract radulae from:

Bembicium nanum (Lamarck)
Littorina (Austrolittorina) unifasciata Gray
Helix (Cryptomphalus) aspersa (Muller)
Deroceras caruanae (Pollonera)

Nomenclature for marine species follows Ludbrook and Gowlett-Holmes (1989) and for the terrestrial species, Smith and Kershaw (1979).

In each case a readily discernible radula was revealed which appeared under the dissecting microscope to be almost free from adhering undissolved soft parts.

Conclusions

The prime purpose of this investigation was to examine the radula of a particular aquatic snail to determine its species using a method that required only household materials. When this proved to be adequate further taxa were tested to see if it had more general application. This also proved to be the case.

No comparisons have been made with the standard techniques of relaxation and sodium hydroxide maceration to see if a quicker or better result is obtained. Nor has the method been tested to see if the radulae are sufficiently clean for staining and the making of permanent mounts, or if other factors have made them unsuitable for that purpose.

The non-specialist should find this method of radula examination to be adequate when simple features are used in keys for determining species. It has the advantage that rarely used chemicasls need not be bought and stored. An interesting extension of the project would be for someone practised in the standard techniques to compare the methods for the preparation of permanent, stained mounts.

Acknowledgements

Thanks are due to the referee of this paper for advice on revised nomenclature for *Glyptophasa* and a recommendation to extend the scope of the initial draft.

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The ascent of Mt William

J. A. D. Blackburn

On 11 July 1836 Major Mitchell obtained his first glimpse of the Grampians and on the 13th they were in full view. The following is an abbreviated account taken from his published journal, using his words, with a minimum of editing to make it more fluent.

"The lofty mountain range was distant between thirty and forty miles so I determined on an excursion to its lofty eastern summit. I perceived that the land immediately to the eastward was very low, and I might conduct a party in that direction to the coast. I was however more desirous to level my theodolite on that summit first, and thus obtain valuable materials for the construction of an accurate map.

I left the party encamped, and proceeded towards the mountain, accompanied by six men on horseback. We crossed, at three miles from the camp, a deep creek. The horse of one of the party plunged in and they parted company in the water, the horse reaching one bank, the rider the other; the latter, who was my botanical collector, Richardson, partly swimming, partly floating on two huge portfolios. I gave his name to the creek. The next day we came to a river with broad deep reaches of very clear water, and flowing towards the north-west. We found a ford, and a tract of white sand where *Banksia* and *Casuarinae* were the chief trees. Here we left our horses.

The first part of our ascent, on foot, was extremely steep and labourious. Above it were two high and perpendicular cliffs, the upper about 140 feet in height. The summit of the cliffs consisted of large blocks of sandstone, separated by wide fissures, full of dwarf bushes of banksia and casuarinae, wet and curiously encrusted with heavy icicles. We had not come prepared to pass the night. We had neither clothing nor food; nor was there any shelter. One man, Richardson, had brought his day's provisions in his havresack (sic) and these I divided equally among five. The thermometer stood at 29(°F), the water, as it boiled, rose to 95 of the centigrade scale. In keeping the fire alive, twigs were blown into red heat at one end, icicles remained at the other, even within a few inches of the flame.

The wind blew keenly, and in the morning the thermometer stood as low as 27(°F). The rocks were more thickly encrusted with ice. The sun rose amid red and stormy clouds and a few isolated hills were dimly visible. I hastily levelled my theodolite and during a short interval I took what angles I could obtain.

The work completed we reached the river where the horses awaited us in three hours, the distance being eight miles from the summit of Mount William. We reached the little river at eight in the evening, and lay down on its bank for the night. As soon as morning dawned I succeeded in finding a ford and reached the camp at an early hour."

Mitchell wrote: "In adding this noble range of mountains to my map, I felt some difficulty in deciding on a name . . . I have always gladly adopted aboriginal names, and in the absence of these, I have endeavoured to find some good reason for the application of others, considering descriptive names the best, such being in general the character of those used by the natives of this and other countries. Names of individuals seem eligible enough, when at all connected with the history of the discovery, or that of the nation by whom it was made . . . I venture to connect this summit with the name of the sovereign in whose reign the . . . region below was first explored; and, it was not without some pride, as a Briton, that I gave the name of the Grampians to these summits."

In keeping with these ideals, three days later he wrote: "Some natives being heard on the opposite bank . . . we ascertained

that the name of the river was the "Wimmera". On September 14 he records that: "A considerable source of the Glenelg, named by the natives the 'Wannon' has its source in the eastern and southern rivulets . . ."

In reading his journal, it is clear that every reasonable effort was made to determine the aboriginal names of topographical features, but this was frequently frustrated by the unapproachability or absence of local inhabitants.

Mitchell lists fourteen new species found on Mt William. These were subsequently described by Dr Lindley and published, in Latin, as footnotes in "*Three Expeditions into the Interior of Eastern Australia*" by Thomas Mitchell (1839), although five of these names are no longer valid.

Species found by Major Mitchell on Mt William in 1836 and described by Dr Lindley.

Leucopogon glacialis
"At the very summit I found a small heath-like bushy *Leucopogon*, from six inches to a foot high. It was in flower, although covered with ice". p. 175, July 14th.

Leucopogon villosus
"Also a variety of *Leucopogon villosus*, with rather less hair than usual, and another species of the same genus, probably new." p. 175, July 14th.

Eucalyptus alpina
"Near the highest parts of the plateau, I found a new species of *Eucalyptus* with short broad viscid leaves, and rough-warted branches." p. 175, July 14th.

Epacris tomentosa (now *E. impressa*)
". . . a most beautiful downy-leaved *Epacris*, with large, curved, purple flowers, allied to *E. grandiflora* but much handsomer." p. 177, July 15th.

Phebalium bilobum
"A most remarkable species of *Phebalium*, with holly-like leaves and bright red flowers resembling those of a *Boronia*." p. 178, July 15th.

Cryptandra tomentosa
"A new *Cryptandra* remarkable for its downy leaves." p. 178, July 15th.

Baeckea alpina (now *B. ramosissima* ssp. *ramosissima*)
"A beautiful species of *Baeckea*, with downy leaves and rose-coloured flowers resembling those of the dwarf almond." p. 178, July 15th.

Pultenaea montana (now *P. scabra*)
"A new *Pultenaea* allied to *P. biloba*, but more hairy, and with the flowers half concealed among the leaves." p. 178, July 15th.

Bossiaea rosmarinifolia
"A new species of *Bossiaea* which had the appearance of a Rosemary bush, and differed from all published kinds in having linear pungent leaves." p. 178, July 15th.

Genetyllis alpestris (now *Calytrix alpestris*)
"A beautiful, new, and very distinct species of *Genetyllis*, possessing altogether the habit of a Cape Diosma, the heath-like branches being terminated by clusters of bright pink and white flowers." p. 178, July 15th.

Grevillea aquifolium
". . . a remarkable kind, with leaves like those of an European holly, but downy . . ." p. 178, July 15th.

Grevillea variabilis (now *G. aquifolium*)
". . . another fine new species, with leaves like those of an European oak . . ." p. 178, July 15th.

Grevillea alpina
". . . a third with brownish red flowers and hoary leaves, varying from an erect straight-branched bush, to a defuse entangled shrub . . ." p. 178, July 15th.

Leucopogon rufus
". . . lastly a new *Leucopogon*, besides that found on the summit as already mentioned." p. 178, July 15th.

Acknowledgements

Thank you to Karen Wilson, curator of the Melbourne University Herbarium, for tracing the nomenclatural changes.

The search for *Helicarion niger*

Karen van Kuyk

The new VCE brings practicality into students' work. This is what Glenn Elliott and I (Year 11, Mary MacKillop College, Leongatha) were looking for when we went searching for a useful Biology project.

Mr. Peter Noonan, Maths/Computer teacher at school, sparked with an idea after receiving a letter from Mr. Ron C. Kershaw from Tasmania and author of "Field Guide to the Non-Marine Molluscs of South Eastern Australia". Mr. Kershaw is studying a particular Gastropod, *Helicarion niger,* found in the South Gippsland area. There was a limit to how many he could dissect from the Launceston Museum so he is now looking for fresh *Helicarion* material. Unfortunately, due to ill health, he cannot make the trip himself.

Several locations where this land snail had been found previously were quite accessible from our homes so Glenn and I decided to take up the challenge. We knew next to nothing about Molluscs but the project appealed to both of us.

We left Leongatha on Wednesday, 7th March for Sandy Point and the dry sclerophyll forests – we later found out that means 'Gum Trees' – after our background reading had shown that the most recent findings of *H. niger* in 1970 were just north of Sandy Point. We determined that the nearby Shallow Inlet would be just the spot.

Aware of our own ignorance we questioned Mr. Noonan closely as to what we were really looking for. He handed us Mr. Kershaw's book, saying: "I'm not quite sure myself!" For us this was a great inspiration!! In fact, *H. niger* is a medium sized snail with a thin, flat, fragile shell of 3 whorls which are glossy and coloured orange-yellow. The animal is black-grey to pinkish buff in colour.

Arriving at the search area we worked vigorously for two hours. We pulled apart dead trees; looked under the foliage; dug in the dirt and tried a wide range of terrain – dense and sparse, high and low.

We did find two different species that day. They were in a low-lying place, under reeds and foliage, in fairly dense bush. They were very tiny and later we identified them as *Pernagera tamarensis* and *Hydrococcus tasmanicus* using Mr. Kershaw's book as our reference. Although the main object of our trip was not achieved we had learnt something from examining what we had found and, from observing the abundant and tiny animals moving about wherever we searched. We decided to give it another go. Next time we would try somewhere not so dry, like the Tarra Valley or the Grand Ridge Road, also suggested by Mr. Kershaw.

Our next trip was on 21st March, two weeks later. We agreed on Toora North which would be wetter than Sandy Point. We crossed a bridge near the Wonga turnoff and stopped. There were many gum trees on steep banks on either side of the river, coming down almost to the water and we could see leaf mould everywhere. We lifted dead logs; we dug in the ground and raked away at the leaf and bark litter. We found our first live gastropods. Once again we had two different species but *Helicarion* had eluded us. They were our only finds for the day in spite of several other stops. We later classified them as *Tasmaphera lamproides,* a 10 mm giant and a smaller *Oxychilus alliarius,* a glass shell. At Wonga we found far more animal life than we had found previously,

The project seemed a failure. We didn't find *H. niger.* However, when we looked at it again we really had learnt. We knew how to classify gastropods, using Mr. Ker-

shaw's book. We knew a lot more than most about a special little land snail. We had found some snails that we'd never thought would live where they do. We had tried our best to help someone with an important investigation.

Perhaps we will have better fortune if we try again after the rains come.

Note: Our identifications of the species found are tentative only and are subject to change quite quickly – especially if we meet someone who knows more than we do.

But the mail did get through

This letter was sent to the Secretary, Field Naturalists Club, Royal Society's Hall, Melbourne.

Post and Telegraph Department
Brisbane 12th December 1882

Sir,

I am to acknowledge the receipt of your communication of the 29th ultimo, relative to the postage charged in Queensland upon specimens of Natural History, and complaining that the two small tin boxes of same addressed by you to Mr Geo. Barnard, Duaringa, although bearing the amount of postage indicated as correct by the Melbourne office, were refused delivery until a sum of 5/- deficient postage and fine should be paid.

In reply, I have to inform you that our Regulations do not admit of specimens of Natural History passing through the Post Office at packet rates.

The area of Victoria is but small compared with that of Queensland and the distances traversed therein by horse mails not very great, whereas in this extensive territory the services by horse are lengthy and numerous. It is therefore not considered desirable to extend the Regulations in the direction indicated.

In the case of Mr Barnard's parcels, referred to, the Postmaster at Duaringa has, under the circumstances, been instructed to give delivery without charge, and the Melbourne Office has been advised of the Regulations of this Department with regard to the specimens mentioned.

I have the honor to be,
Sir,
Your obedient servant
F.E. Salisbury
for Under Secretary

From F.N.C.V. archives

The new museum on the South Bank

(Report of a talk by Dr J. M. Bowler at the June meeting of the F.N.C.V. on Monday, 16th June, 1990)

Background

The deputy director of the National Museum of Victoria, Dr Jim Bowler, spoke enthusiastically about the imminent, future plans for the new museum to be located opposite the World Trade Centre on the south bank of the Yarra River, adjacent to, and just west of Spencer Street.

Dr Bowler reported of the neglect the National Museum had suffered over the last few decades when other academic institutions were upgrading and amalgamating. Bob Edwards, the former director, had received a commitment from the State Government to go ahead with the construction of a new technology museum at Spotswood. This section of the Museum will open in June 1991.

A new building is to be built on the south bank of the Yarra River to house the other sections of the Museum, especially the Natural Science and Ethnological sections. The size of the new building will equate in area to that presently occupied by that of the existing Museum and National Library together. The cost in 1987 was estimated to be $170 million. (At present this cost has escalated with inflation to over $200 million).

The commitment is a firm one and it will be difficult for the Government to back out for the following reasons –

(i) The State Library is to occupy the premises vacated by the Museum. The Library has a strongly organized pressure group, and their management urgently needs space to expand.

(ii) The architect now has final plans for the south bank site to submit to Cabinet for approval.

The museum and the community

The Museum is keen to revitalize the natural sciences and those groups promoting the natural sciences in the community. National terrestial parks have already been established through the work of Sir Baldwin Spencer and the field naturalists' clubs. At present marine parks are being established in Victoria, and their development is similar to the stage that establishment of terrestial national parks were at 40 years ago. Just to determine what life is in these parks requires the research efforts of a large number of people, apart from the specialised work of Museum staff. Thus the work of FNCV and related groups would be valued and encouraged by the museum to complete such census tasks.

The Museum is keen to promote environmental education. Recently 60 interested people were conducted by Museum staff and members of the Marine Research Group over sites at Corner Inlet and Wilson's Promontory, in the study of food chains. Similar conservation strategies would be initiated by the Museum with field naturalists. It is important therefore, that the Museum should provide facilities for such groups to meet and conduct joint programs.

Housing specimens

Fifteen million objects have to be stored in the natural history section of the museum. Most of these are invertebrate specimens. Eight hundred square metres of space costing $1.6 million is needed just to house palaeontology alone. In the light of the universities deleting palaeontology from courses in geology it is essential that the Museum staff carry the responsibility of teaching the whole story of life, past and present. This has to be done in an exciting and interesting way, to teach and stimulate the community. To do this will demand imaginitive ideas from staff and interested groups.

Exhibitions

Money is required to develop worthwhile exhibitions as has been seen recently with the dinosaur and Egyptian exhibitions. At present, the existing natural science exhibits could be greatly improved. Creativity and imagination are required to present the essential concepts, which need to be communicated to the visiting public.

The new building

The site opposite the World Trade Centre and east of the Polly Woodside site is interrupted on the south east corner by the old refurbished, privately owned Tea House. Ideally the site needs to be accessed to complete the unit, but would cost $6 million. It is planned to scallop out the south bank in a concave fashion to match a similar feature on the Trade Centre frontage. Clearing of the site has already begun.

If one arrives at the Museum site, either by boat or by bus from Spencer Street, the approach from the north east side would be through a long concourse introducing visitors to exhibition structures leading off on either side of the concourse to curatorial areas.

The Omnimax Theatre

The Onimax Theatre is a domal projection area, where the observer sees the picture completely surrounding on the inner surface of a hemispherical wall. It is a Japanese and American innovation, being ideal for space and astronomy films, and is anticipated for Antarctic and Barrier Reef vistas.

The Omnimax Theatre will be the first structure built on the site. It will be built on time, as substantial penalties are to be built into the contract to ensure its construction is punctual. It will be a revenue raiser for the Museum. Aboriginal artefacts, art and exhibitions should also serve in this respect as well.

Points made at question time

1. The plan allows for additions and extensions possible towards the south west. (Maybe the Tea House could be purchased in the future.)
2. 40 new staff have been added since last spring. However the institution is expanding from a very depressed base. Ten personnel have joined the Natural Science section.
3. Meeting rooms will be available for ancillary groups, e.g. FNCV, Friends of the Museum, MRG, Malacological Society, etc.
4. The concept in the design is to keep all sections together.
5. The general structure at this stage is fixed and agreed upon.
6. Shared laboratory facilities would be available for specialist groups together with coffee lounges.
7. If the Olympic Games come to Melbourne in 1996, the Museum program will be given the impetus to be completed by 1995, or before the Games visitors arrive. At present, there is a 5-year time scale to complete the resiting of the Museum.

Members appreciated the clear presentation, sincerity and frankness shown by Dr. Bowler in his talk.

Noel Schleiger,
(Program Secretary).

Tasmanian sea shells common to other Australian States

by Margaret H. Richmond

Publishers: Richmond Printers, Devonport, Tasmania.
r.r.p. $30.00 (softcover), $45.00 (hard cover).
(Special discounts if purchased through clubs).

This, the first book on Tasmanian shells illustrated in full colour, is a thin A4 sized volume dealing with 170 gastropod and bivalve species. Published in case bound and soft bound format it clearly does not replace W. L. May's "Illustrated index of Tasmanian shells" which figured 1,052 species on 47 plates. It does concentrate on those shells most likely to be seen by the average enthusiast, adult or child. Furthermore the figures are readily identifiable.

The short introduction provides basic molluscan data, a useful glossary, figures illustrating shell descriptive features and eleven useful Australian literature references. The book is a valuable tool for the collector and naturalist seeking the identity of common shells of southern Australian shores. Most figures are clear and the species of natural size. Small species usually have an adjacent enlargement but *Nassarius nigellus* (p.32) and *Dentimitrella pulla* (p.31) would also have gained in this way. The care taken selecting photographs is reflected in the high quality results.

The plates are not cluttered so that each species is easy to find. The facing page in each case provides species and common names with a small map showing Tasmanian distribution with a list of mainland states also included in the pattern. Ordinal and family names lead quickly to the subject matter supported by brief descriptions and useful comments. The Tasmanian coastline is divided into segments each of which has a detailed map showing beach localities at which the author obtained her material. Beaches are clearly named, numbered and listed on pages 63-64 together with the number of times each was searched for shells. Each shell is tabled by number and locality providing valuable distribution data. Visitors should easily find beaches and know what to expect.

Obvious errors include the miss-spelling of *Phallium* (p.79) and the omission of "Pot" from "Strange's Watering Pot" (p.80). On page 49 the name of E. A. Smith has reversed initials while Tenison Woods may have a hyphen inserted occasionally. The title page to the Gastropods section has two somewhat disconcerting faded and reversed figures. The author, who is a perfectionist, says there are a number of small faults which she tried hard to eliminate but these clearly do not detract from the result. The work was checked by Australian Museum experts for taxonomic accuracy so that it can be recommended without hesitation to students and any lover of shells, large or small.

R. C. Kershaw,
Honorary Research Associate,
Queen Victoria Museum and
Art Gallery, Launceston.

The Mornington Peninsula – A field guide to the flora, fauna and walking tracks.

by Ilma Dunn, Stephanie Rennick and Caroline Grayley

Publishers: The Southern Peninsula Tree Preservation Society (1990). 64 pp, 148 colour plates, r.r.p. $14.95 (soft cover).

Launched at the Shire of Flinders Offices, Rosebud, on 18th July, a small book under the above title adds a new dimension to the sparse literature currently available on the natural history of the Mornington Peninsula. Here is a most alluring collection of 148 beautifully clear colour pictures, chiefly the work of talented photographer, Mrs Ilma Dunn; they embrace herbs, climbers, small shrubs, a few trees, ferns, fungi, lichens, birds, mammals and insects, as well as representative scenery – from coastal cliffs to fern gullies in the wetter interior of the Peninsula. On pages 34 and 35 a set of seven colour photographs depicts the life history of the Imperial White Butterfly.

All pictures are appropriately annotated and the whole grouped according to broad habitats: foreshore, open forest, sheltered gullies, etc. A centrefold sheet gives information on 47 access points to interesting walks, on one side, and a ten-coloured map showing geological formations on the other. Full indices to flora and fauna occupy pages 58-62, and references for further reading appear inside the back cover. Not a scrap of space is wasted, even on the inside covers. If there are any mistakes in this excellent field guide, the reviewer is unaware of them; meticulous care has been taken to ensure that the text is accurate and up-to-date.

As the three authors aver (p. 3), "Knowledge of the flora and fauna should assist in their protection, as well as adding pleasure and a sense of discovery to the experience of the sharp-eyed walker". While congratulating all concerned in the production of such an attractive, useful book, one can confidently recommend it as a model source of local information. May it serve to extend concern for conservation of the long embattled native plants and animals of the Mornington Peninsula.

J. H. Willis,
Brighton, Vic.

---

21 years of the Montmorency Field Naturalists Club

The Montmorency Field Naturalists Club has its origins in a junior club which began in March 1969. Mrs Lorna Cookson, having a young son with pockets always full of beetles, etc., decided a naturalist club would be a good thing. Together with her neighbours and friends and guidance from the Field Naturalists Club of Victoria, she started a very successful organisation. 142 Juniors signed on at the first meeting! Membership numbers are considerably reduced today, due to the competition from TV, etc., but a dedicated group keeps the M.F.N.C. alive and well. On March 9 this year over 40 people attended the 21st Birthday Meeting. Distinguished guests included Lorna Cookson, Ray Wilton (the first President), Dan McInnes (the first Guest Speaker) and many past members. It was interestng to learn of the achievements of many of those early Juniors, whose talents were fostered by M.F.N.C. To mention a few, Dr. Laurie Cookson is working on marine borers at C.S.I.R.O., Michael Braby is studying for a Ph.D. in Entomology, Margaret Howard has an M.Sc. in Genetics and Nancy Endersby, B.Sc. Hons, works for the Department of Agriculture. Notable achievements of the Club have been a Reptile Survey of Kinglake National Park and the discovery and preservation of the Eltham Copper Butterfly.

We hope to continue for at least another 21 years. New members of all ages and visitors are always welcome. Enquiries: Elaine Braby 439 9015.

ERRATUM

There were a large number of errors in the appendix of Lindenmayer *et al* (1989). A survey of the distribution of Leadbeater's Possum, *Gymnobelideus leadbeateri*, McCoy in the Central Highlands of Victoria, Victorian Nat. **106** (5); pp 177-8. The corrected appendix is reproduced here in full. All errors were the responsibility of the authors.

Appendix

The latitude and longitude to the nearest degrees and minutes for all records has been determined from 1: 100 000 NATMAP topographic maps. Elevation of survey sites has been estimated from 1: 25 000 Fire Control maps supplied by the Board of Works.

Lat. Long.	Alt. (m)	Location
37 41 145 44	800	Acheron Gap.
37 22 145 47	1000	Blue Range Rd.
37 45 146 11	900	1 km E bridge, Upper Thomson River.
37 42 146 10	960	Upper Thomson River.
37 45 146 10	1060	Upper Thomson Rd.
37 40 146 07	1040	2 km N Mt. Gregory.
37 41 146 07	1100	3 km S Triangle, on Noojee-Matlock Rd.
37 43 146 08	1020	4 km SW Mt. Gregory, Rd. 11, Upper Yarra Catch.
37 39 145 45	800	3 km N Acheron Gap.
37 45 146 08	1040	5 km NE Toorongo.
37 49 146 10	600	1 km E Tanjil Bren.
37 45 146 09	1020	Cnr. Thomson Valley, Noojee/ Matlock Rd.
37 23 145 48	1040	4 km W Rubicon Dam.
37 39 145 42	800	Cnr MMBW Tks. No. 8 and 27, Upper Yarra Catch.
37 48 145 48	800	0.5 km. NE Starlings Gap on Big Ck. Rd.
37 49 145 49	800	Gap Tk., Starlings Gap.
37 48 145 52	760	Cnr. Federal Short Cut and Federal Rd.
37 50 145 51	760	Cnr Big Tree Walking Tk. and Federal Rd.
37 35 145 38	440	"The Hermitage", Maroondah Hwy.
37 54 145 42	680	1.7 km. SE T/o Bunyip Rd. and A.P.M. Tk.
37 54 145 47	780	Cnr. Woodalls Tk. and Pioneer Ck. Rd.
37 48 145 49	820	Cnr. Big Ck. Rd. and Mississippi Fireline.
37 42 145 39	1000	1 km. E Ben Cairn, Mt. Donna Buang Rd.
37 35 145 38	520	2 km. SW Dom Dom on Maroondah Hwy.
37 49 145 46	800	Cnr. Fitzpatrick Tk. and Blacksands Rd.
37 54 145 45	800	Burgess Fire Trail 1 km. Nth Kobiolkes Tk.
37 32 145 30	560	Cnr. Sylvia Ck. and Coles Ck. Rds.
37 41 146 07	1000	17 km Rd. 9, Upper Yarra Catch.
37 46 146 04	1040	13 km Rd. 20, Upper Yarra Catch.
37 43 146 08	1020	10 km Rd 11, Upper Yarra Catch.
37 40 146 06	1060	1.5 km Rd. 10 T/o with Rd. 9, Upper Yarra Catch.

Lat. Long.	Alt. (m)	Location
37 38 145 56	700	2 km on Rd. 27, Upper Yarra Catch.
37 39 146 07	1060	3.2 km W Triangle, Woods Point Rd.
37 31 145 55	960	Koala Falls, Cambarville Rd.
37 43 145 37	800	1 km W Ben Cairn, Mt. Donna Buang Rd.
37 34 145 37	720	Cnr Rd. 9 and Monda Tk., Maroondah Catch.
37 34 145 32	880	Cnr. Hardies Ck. Rd. and Monda Tk.
37 36 145 39	600	3 km. Rd. 8, Maroondah Catch.
37 35 145 36	800	Cnr. Rds. 13 and 35, Maroondah Catch.
37 35 145 37	580	2.5 km on Rd. 9, Maroondah Catch.
37 38 145 39	740	1.1 km from Viewpoint. 1, Rd. 3 Maroondah Catch.
37 39 145 41	780	8 km Rd. 27., Maroondah Catch.
37 39 145 50	520	12 km. Rd. 1, O'Shannassy Catch.
37 37 145 45	1140	0.7 km. Rd. 8, O'Shannassy Catch.
37 37 145 44	1080	3.9 km Rd. 8, O'Shannassy Catch.
37 38 145 49	1140	0.8 km. Rd. 5, O'Shannassy Catch.
37 37 145 49	840	2.9 km. Rd. 5, O'Shannassy Catch.
37 36 145 49	700	7.5 km. on Rd. 12, O'Shannassy Catch.
37 41 145 44	900	0.2 km. Rd. 14, O'Shannassy Catch.
37 34 145 34	820	Cnr Rd. 9 and Block 6 Rd., Toolangi.
37 36 145 36	580	1 km. Rd. 39, Maroondah Catch.
37 22 145 55	1000	Conns Gap Rd., 0.5 km. T/o Snobs Ck. Rd.
37 21 145 53	1000	1.3 km on Tk. 6, T/o Snobs Ck. Rd.
37 41 145 39	1020	17.2 km on Rd. 3, Maroondah Catch.
37 37 145 48	1180	Cnr Rds. 5 and 1, O'Shannassy Catch.
37 50 145 48	800	Mackley Ck., Crossing with Big Ck Rd.
37 33 145 53	800	Big Tree Tk., Cambarville.
37 33 145 53	840	Snowy Hill Rd., Cambarville.
37 30 145 49	900	Cnr. Tommy's Bend Rd. and Yellow Dog Rd.
37 26 145 48	1100	Blue Range Rd., 1.5 kms S T/o Tweeds Spur Rd.
37 23 145 48	1100	Little River bridge, Blue Range Rd.
37 25 145 48	1000	Storm Ck., 1 km W Blue Range Rd.
37 33 145 31	960	Northern slopes Mt. St. Leonard.
37 34 145 33	860	Hardy's Ck. Rd., 1.5 km NE T/o Monda Tk.
37 30 145 31	920	4.2 km N Mt. St. Leonard.
37 46 146 03	1130	0.7 km W summit Mt. Horsfall.
37 45 146 12	1120	Thomson Valley Rd.

EDITORIAL POLICY

Title

The Victorian Naturalist is the bimonthly publication of the Field Naturalists Club of Victoria.

Scope

The Victorian Naturalist publishes articles on all facets of natural history. Its primary aims are to stimulate interest in natural history and to encourage the publication of articles in both formal and informal styles on a wide range of natural history topics.

Research Report

A succinct and original scientific communication. Preference is given to reports on topics of general interest.

Contributions

Contributions may consist of reports, comments, observations, survey results, bibliographies or other material relating to natural history. The scope is broad and little defined to encourage material on a wide range of topics and in a range of styles. This allows inclusion of material that makes a contribution to our knowledge of natural history but for which the traditional format of scientific papers is not appropriate.

Naturalist Notes

Short and informal natural history communications. These may include reports on excursions and talks.

Commentary

Informative articles that provide an up-to-date overview of contemporary issues relating to natural history. Whilst commentary articles are invited, the editors welcome discussion of topics to be considered for future issues.

Book Reviews

Priority is given to major Australian publications on all facets of natural history. Whilst reviews are commissioned, the editors welcome suggestions of books to be considered for review.

News

Any items of news concerning the FNCV.

Diary

Notice of coming events including activities of FNCV groups and any other activities of interest to *Vic. Nat.* readers.

Review Procedures

Research reports and Contributions are submitted to the editors and are forwarded to the appropriate member of the editorial board for comment. All research reports are assessed by two independent qualified referees prior to publication. Contributions are assessed by the appropriate member of the editorial board and may be refereed at the editors discretion. All other articles are subject to editorial review.

FNCV Diary *(cont.)*

Fauna Survey Group

Contact the group secretary, Alex Kutt, 347 0012 A.H., for information on meetings and excursions.

Excursions

Saturday, 6th October
Night. Leadbeater Possum Watch.

Sat-Sun, 20th-21st October
Water Rat Survey. Werribee Farm.

Sat to Tues. 3rd-6th November
Nooramunga Marine Coastal Park.

Saturday, 10th November
Night. Leadbeater Possum Watch.

Saturday, 24th November
Night. Leadbeater Possum Watch.

Sat-Sun, 8th-9th December
Water Rat Survey. Werribee Farm.

Saturday, 15th December
Night. Leadbeater Possum Watch.

Wednesday, 26th December to 2nd January (or longer)
Xmas Camp. Nooramumga Marine Coastal Park. Sunday Island.

Geology Group

Group Meetings (Third Wednesday)

Wednesday, 3rd October
"Metamorphism" Roger Powell (Melb. Uni.).

Wednesday, 7th November
"Ashton Mining" (Diamonds).

Wednesday, 5th December
Members Social Night.

Field Naturalists Club of Victoria

In which is incorporated the Microscopical Society of Victoria

Established 1880

Registered Office: F.N.C.V., c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron

His Excellency, The Rev Dr John Davis McCaughey, The Governor of Victoria.

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Group Secretaries

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Microscopical: Mrs. ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1990

Metropolitan Members (03 area code)	$27
Joint Metropolitan	$30
Country/Interstate members	$24
Joint Country/Interstate members	$27
Concessional rate (Students/pensioners) (proof of entitlement required)	$20
Joint Concessional	$23
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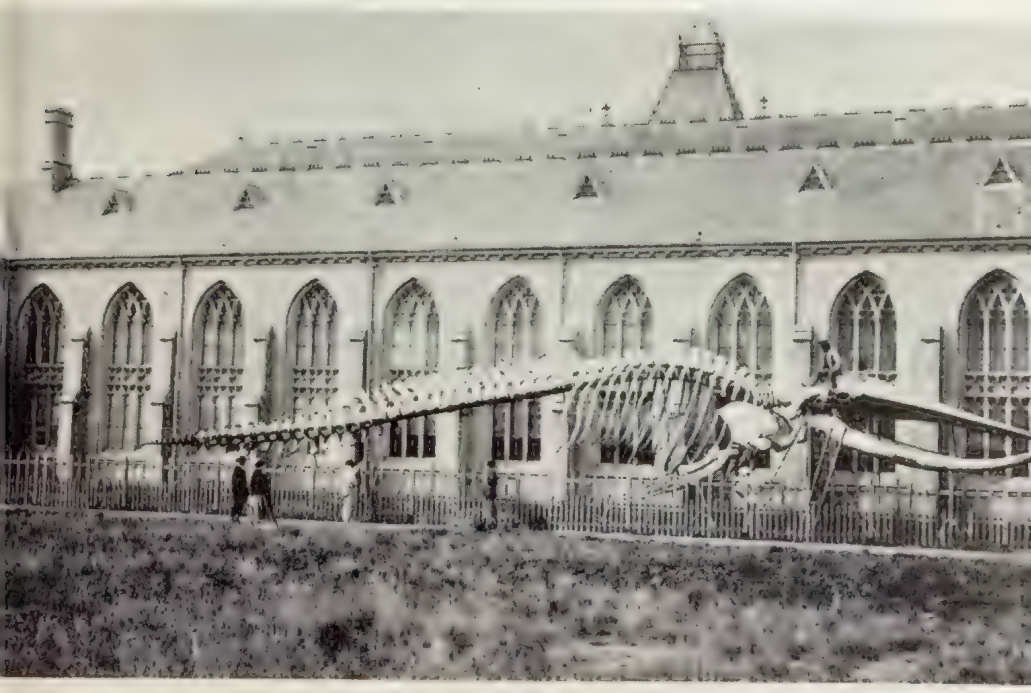

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FNCV DIARY

General Meetings

Held on the second Monday of the month (except for public holidays), 8.00 p.m. at the National Herbarium Hall, corner of Birdwood Avenue and Dallas Brooks Drive, South Yarra. Meetings include a talk by a guest speaker. All members of the public are welcome.

Monday, 11th February
Spiders.
Wendy Clarke.

Sunday, 17th March
Hosted by the Fauna Survey group.

FNCV Excursions

For further information on excursions contact Dorothy Mahler (850 9379 A.H.).

6th-12th January
Excursion to Gypsy Point.

Sunday, 3rd February
Lancefield Marsupial Megafauna Fossils. Sanya van Huet.

Sunday, 3rd March
Spiders and general natural history.
Gerard Marantelli.

Group Activities

Botany Group

Group Meetings (second Thursday)

Thursday, 14th February
To be announced.

Thursday, 14th March
Biology of seaweeds.
Mrs. Iona Christiansen and panel.

Excursions

Saturday, 23rd February
Rainforest at Toolangi.
David Cameron.

Saturday, 23rd March
Seaweeds at Mornington.
Mrs. Iona Christiansen.

Microscopial Group

Group Meetings (Third Wednesday)

Wednesday, 16th January
Members night.

Wednesday, 20th February
Chemistry of stains.

Wednesday, 20th March
Phase contrast and modulation contrast in microscopes.

Geology Group

Group Meetings (First Wednesday)

Wednesday, 6th February
Members night.

Wednesday, 6th March
Weather and climate on other planets.
Dr. Tim Gibson.

Wednesday, 3rd April
Geomorphology. Mrs Gabi Love.

From the Editors

Owing to the re-location of the printers of *The Victorian Naturalist,* the last two issues for 1990 have been combined into one large edition to bring the journal to readers before the christmas period.

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Cover photo: Blue Whale skeleton collected at Jan Juc Victoria in 1867 by Prof. McCoy. Displayed outside the old Union Building, University of Melbourne. Photo courtesy of the Museum of Victoria.

Distribution, habitat and conservation status of the Giant Burrowing Frog, *Heleioporus australiacus* (Myobatrachidae), in Victoria

Graeme R. Gillespie*

Introduction

The genus *Heleioporus* contains six species, all of which are endemic to Australia. The Giant Burrowing Frog, *Heleioporus australiacus* (Shaw and Nodder 1795) , is the largest of these moderate to large, globular burrowing frogs (Fig. 1), and it is the only member of this genus found in eastern Australia. The disjunct distribution between the western and eastern species in this genus is discussed by Lee (1967).

The known distribution of *H. australiacus* extends from the central coast of New South Wales to eastern Victoria (Fig. 2). Within New South Wales the status of this species is uncertain. An extensive survey of the herpetofauna in the Bega district on the New South Wales coast (Lunney and Barker 1986) indicated that the species is rare. However, it appears to be common throughout the Hawkesbury Sandstone in the Sydney area (Barker and Grigg 1977; Dr. A. Lee - Assoc. Dept. Zoology, Monash University, pers. comm.).

In Victoria, little was known about the distribution of *H. australiacus* prior to 1983, as only five specimens had been recorded. The first specimen, from Tongio West near Omeo, was recorded in January 1903 (Anon 1903). Not until 1965 were two more specimens collected, adjacent to the Cann Valley Highway, in Wet Sclerophyll Forest, 200 and 300 metres south of the state border respectively (Littlejohn and Martin 1967). In February 1967, two more specimens, as well as egg masses, were collected five kilometres north of Boola Camp near Erica (Littlejohn and Martin 1967). As a result of intensive fauna surveys in eastern Victoria by the Department of Conservation and Environment in the past eight years, many more specimens have been found. In this paper, these additional records are presented, and the current knowledge and status of this species in Victoria is reviewed.

* Department of Genetics and Developmental Biology, Monash University.

Species Description

Lee (1967) and Cogger (1986) have described *H. australiacus* as follows:

> A large, robust species, with maximum body length (snout-vent) of 100mm (Fig. 1). Body colouration is a uniform chocolate brown above, white below, with the throat frequently washed with brown. There are scattered white or yellow spots, 1-3 mm in diameter, usually capping warts on the sides and around the cloaca, and occasional spots on the proximal segment of forelimbs and hindlimbs. The back and sides are covered with warts, each capped by a small spine. Black spines may also occur on the throat, the ventral surface is otherwise smooth. A small divided flap is present in the anterior corner of the eye. The tympanum is prominent. The girth of the forelimbs usually exceeds the girth of the hindlimbs in males, but never in females. The fingers and toes are without webbing. The compressed inner metatarsal tubercle is slightly less than one half the length of the fourth toe. A series of conical black spines is prominent on the first, and usually second and third fingers of males, the largest up to 5 mm in length on the metacarpophalangeal knuckle of the first finger.
>
> The call is a low-pitched, owl-like, "ou-ou-ou", with a repetition rate of 18-24 calls per minute (Littlejohn and Martin 1967).

Distribution and Habitat

The presently known distribution of *H. australiacus* in south-eastern Australia is illustrated in Fig. 2. Records of this species from Victoria, since 1982, are summarized below:-

1. Waratah Access Track, approximately 500 m east of Waratah Flat, East Gippsland, Victoria: January, 1983. (Australian Map Grid Reference 8623 390720). One gravid female (released) was observed crossing a track at night, after a heavy thunderstorm. This site is on the boundary between *Leptospermum glabrescens* thickets and Low Montane Riparian Forest, dominated by *Eucalyptus viminalis* (Manna Gum) and *E. radiata* (Narrow-leaved Peppermint), with an open understorey (Chesterfield *et al.* 1983).

2. Yalmy Road, East Gippsland: February, 1983. (AMG 8623 415717). One male (photographed, released) recorded calling from a burrow adjacent to a fire dam in Damp Sclerophyll Forest dominated by *Eucalyptus obliqua* (Messmate Stringybark), *E. cypellocarpa* (Mountain Grey Gum) and *E. sieberi* (Silvertop Ash), with an open understorey (Chesterfield *et al.* 1983; Opie *et al.* 1984)

3. 300 m south of the New South Wales/Victorian border, 800 m north west of Coast Range Road, East Gippsland: February, 1984. (AMG 8723 856850). One individual crossing a track at night following heavy rain. The vegetation at this site is Dry Sclerophyll Forest, dominated by *Eucalyptus radiata* and *E. dives* (Broad-leaved Peppermint) (Carr *et al.* 1984)

4. Scorpion Creek, Central Gippsland: February, 1984. (AMG 8523 947612). One male was recorded calling from under a log jam in the creek. Riparian

Fig. 1. Giant Burrowing Frog *(Heleioporus australiacus)*, Coast Range, East Gippsland, Victoria. (Photo: Graeme R. Gillespie).

Fig. 2. Five minute grids in which *Heleioporus australiacus* has been recorded. Open grids represent records in Victoria prior to 1982 and all records from New South Wales (Australian Museum Records; Littlejohn and Martin 1967; Lunney and Barker 1986; Webb 1987). Solid grids represent post-1982 records from Victoria and numbers correspond with those in text. Hatched grids represent breeding records in Victoria (Littlejohn and Martin 1967).

vegetation was present along the creek, with forest dominated by *Eucalyptus cypellocarpa* and *E. radiata* along the adjacent slopes (Macfarlane *et al.* 1984).

5. Buldah Gap Road, 1.8 km south of the Bonang Highway, East Gippsland: January, 1986. (AMG 8623 936702). One juvenille (photographed, released) was collected from a pitfall trap in Dry Sclerophyll Forest dominated by *Eucalyptus globoidea* (White Stringybark) and *E. sieberi*, with a sparse gound cover (Cherry *et al.* 1986).

6. Sardine Creek Road, 1.8 km south of the Bonang Highway, East Gippsland: January, 1986. (AMG 8623 489613). Individual frogs were recorded crossing the road on two consecutive nights, following a period of prolonged rainfall (released). Vegetation at this site comprised Dry Sclerophyll Forest dominated by *Eucalyptus globoidea* with some *E. bridgesiana* (Applebox) and *E. polyanthemos* (Red Stringybark) (Chesterfield *et al.* 1988). A sample of the surface soil at this locality was identified as a fertile sedimentary soil, with a loamy sediment and fairly high organic content (Graeme Love – Geological Adviser, Department of Defence, Glex Field Unit, St. Kilda West, Victoria pers. comm.).

7. Near the junction of Far Creek Track and Hepburn Road, Coast Range, East Gippsland: December, 1986. (AMG 8723 801819). Two males [95 mm and 70 mm (snout-vent), photographed, released] were collected from a pitfall trapline along a slope, adjacent to Swede Creek, after a heavy rain storm. The Montane Sclerophyll Woodland at this site is dominated by *Eucalyptus dalrympleana* (Mountain Gum) and *E. radiata*, with a sparse middle stratum of *Acacia dealbata* (Silver Wattle) and *A. melanoxylon* (Blackwood) (Opie *et al.* 1990). A sample of the surface soil collected at this locality was identified as being a highly fertile volcanic soil, with a high organic content (Love pers. comm.).

8. Central Gippsland, 1 km south of Mount Budgee Budgee: April, 1987, and March, 1988. (AMG 8322 150382). On each of two occasions, one individual was observed on a track (fate unknown). The site was at mid-slope, with Damp Sclerophyll Forest dominated by *Eucalyptus obliqua, E. cypellocarpa, E. muellerana* (Yellow Stringybark) and *Acacia obliquinerva* (Mountain Hickory Wattle), with a scant ground cover (V. Hurley – Forester, Heyfield Work Centre, Department of Conservation and Environment pers. comm.).

9. East Gippsland, 5 km south of Mount Puggaree: May, 1988. (AMG 8622 650385). One individual (released) was observed crossing an old logging track along a ridge at night. Vegetation at this site was approximately 20 year-old regrowth Dry Sclerophyll Forest, dominated by *Eucalyptus sieberi* and *E. baxteri* (Brown Stringybark), with a middle storey of *E. baxteri* saplings, *Persoonia confertiflora* (Clusterflower Geebung) and *Acacia mucronata* (Variable Sallow Wattle) (M. Collins – Zoologist, Department of Zoology, La trobe University, Victoria pers. comm.).

10. Mount Alfred, East Gippsland: May 1989. (AMG 8322 392360). One male [100 mm (SV), photographed, released] unearthed as a result of the uprooting of a tree stump. This site was on a ridge in Dry Sclerophyll Forest dominated by *Eucalyptus cypellocarpa, E. bosistoana* (Coastal Grey Box) and *E. globoidea*, with a sparse understorey (J. Reside – Department of Conservation and Environment Office, Bairnsdale pers. obs.).

11. Black Forest Creek, East Gippsland: March, 1990. (AMG 8723 845857-846859). (Gerard O'Neil pers. comm. Department of Conservation and Environment, Orbost). Tadpoles were located at six sites along a 300 m stretch of the stream by the author. Black Forest Creek is a predominantly narrow (less than 1 m width), swift-flowing stream, however the tadpoles were located in relatively calm, deep sections. The earthen banks of the stream support a dense growth of *Blechnum nudum* (Fish-bone Water Fern), *Carex appressa* (Tall Sedge) and *Gahnia sieberiana* (Red-Fruit Saw Sedge), and the adjacent slopes are characterised by Montane Sclerophyll Woodland. Several individuals were collected and reared for positive identification.

These records of *H. australiacus* and also those from New South Wales (Littlejohn and Martin 1967; Moore 1961; Lunney and Barker 1986; Webb 1987; Australian Museum Records) are all confined to the south-eastern slopes of the Great Dividing Range, at elevations below 1000 m. The distribution of this species is within the Eastern Bassian Subregion of Australia, as described by Littlejohn (1967). This subregion is characterised by a non-seasonal rainfall, with either a uniform distribution, or a slight summer maximum. All of the known records of *H. australiacus* in Victoria have been from eucalypt forests. The absence of records from cleared land suggests a dependence upon forest habitats. Chesterfield *et al.* (1983) recorded one individual in a *Leptospermum* thicket but noted that it was close to adjacent Montane Riparian Forest. The vegetation at sites where *H. australiacus* has been recorded encompasses a wide range of forest communities (Montane Sclerophyll Woodland, Montane Riparian Forest, Wet Sclerophyll Forest, Damp Sclerophyll Forest, Dry Sclerophyll Forest) that together occupy a large area of eastern Victoria. The plant community definitions used here are based on those of Forbes *et al.* (1981).

Montane Sclerophyll Woodland includes low forest or woodlands of rocky mountain soils, generally of northern aspects with low effective rainfall. The major occurrence is on the west and east flanks of the Cobberas-Nunniong region, with isolated occurrences at Mount Tingaringy and Bendoc (800-1100 m). Montane Riparian Forest is restricted to gullies and stream margins of sub-alpine and montane valleys, being most common on the Nunniong Plateau and near Mount Misery and the Cobberas (900-1500 m). Wet Sclerophyll Forest includes tall, open forests of well watered slopes throughout the eastern ranges (200-1200 m). Damp Sclerophyll Forest has affinities with Lowland Sclerophyll Forest, which is the most abundant community in East Gippsland; characteristically open forest of the lowlands, occurring from near the coast to the foothills in a broad band from east to west (80-400 m). This community is dominated by *Eucalyptus sieberi* and *E. globoidea*, with many variants depending upon aspect, draining, soil type and altitude. Dry Sclerophyll Forest comprises a diverse and widespread range of foothill forests (200-900 m), usually with a sparse shrub layer dominated by opportunistic species, whilst the ground consists of semi-shrubs and herbs (Parkes *et al.* 1985).

The vegetation on the Hawkesbury Sandstone, where many individuals have been recorded, consists of "xeromorphic woodlands and shrubs" (Beadle 1962) of high rainfall but low soil moisture retention.

The small number of records of *H. australiacus*, and the wide range of forest types from which it has been recorded, make it difficult to identify habitat preferences of this species. However, no individuals of *H. australiacus* have, as yet, been recorded in rainforest or in tall open forests dominated by *Eucalyptus regnans* (Mountain Ash) or *E. delegatensis* (Alpine Ash).

Heleioporus australiacus may be excluded from farmland if the larvae are

dependent upon small flowing streams (Harrison 1922). Such streams tend to be degraded by land clearing due to increased silt loading from erosion and changes in the water chemistry (Langford and O'Shaughnessy 1980). These changes may inhibit larval development and thereby eliminate the species from the area. This species has been recorded from a dam on one occasion, however, this was within a forested area.

Life History

Lee (1967) described aspects of the life history of *Heleioporus* spp. in Western Australia. He observed that the breeding activity of these species is confined to a period of approximately six weeks – from the onset of winter rains until ephemeral pond sites fill. These species construct burrows in, or adjacent to ephemeral ponds from which males will call, and in which mating and oviposition occurs. Sufficient rainfall is required, on completion of embryonic development, to flood the burrows and release the larvae into the ponds. Three to five months are required for completion of larval development.

As yet, little is known of the life history of *H. australiacus*. Moore (1961) heard males calling from burrows in sandstone cliffs near Sydney in August, September and March. Littlejohn and Martin (1967) have recorded this species calling in eastern Victoria during December and January; two individuals were calling from burrows in banks of shallow creeks, and one amongst debris in the middle of a small pool. Chesterfield *et al.* (1983) recorded one individual calling in February from a burrow adjacent to a fire dam, and Macfarlane *et al.* (1984) also recorded one calling in February from under a log jam in a creek.

The eggs are unpigmented and encapsulated by a foamy mass (Watson and Martin 1973). In four egg masses examined by Watson and Martin (1973), the egg count ranged from 775 to 1239. Watson and Martin (1973) have described the larvae of *H. australiacus* as unspecialised, with a median anus, the mouth disc containing six upper and three lower labial teeth rows, and an anterior gap in the papillary border. The tadpoles are large, reaching a total length of 75 mm (G. R. Gillespie pers. obs.).

Spawn believed to belong to *H. australiacus* was found in a burrow near Sydney in April, by Fletcher (1984). Harrison (1922) found larvae in small flowing streams and observed metamorphosis during October and November. From records in the Sydney region he concluded that there was a limited spawning season in autumn, during which he had also heard the species calling. However, Littlejohn and Martin (1967) collected spawn near Walhalla, in Victoria, in February. Lee (1967) collected a spent female in January, and Chesterfield *et al.* (1983) believed that the female they collected in January, was gravid. Two of the tadpoles collected by the author in March had completed metamorphosis by early May, while others ceased to develop past growing hind limbs. This may be indicative of over-wintering, whereby late-developing tadpoles delay completion of their development until more favourable conditions return in spring. This strategy has been reported in other species of amphibians (Duellman and Trueb 1986).

These records suggest that the breeding season may begin in summer and continue through to autumn, with larval life occupying up to six months, through to October and November.

The timing of breeding of *H. australiacus* is not limited by seasonal water availability as are its congeners in the west. Consequently, a longer breeding season is not unexpected.

With only two exceptions, all vocal records of *H. australiacus* have been from individuals in burrows, usually adjacent to water. Watson and Martin (1973) noted that egg masses were deposited in standing or flowing water, concealed in

vegetation or in burrows. *Heleioporus australiacus* appears to primarily utilize small flowing streams as breeding sites. The record of a male calling from a dam indicates that these may also be used as breeding sites. However, subsequent visits to this site in the months of October, November, February and March have failed to detect this species (G. R. Gillespie pers. obs.; Opie *et al.* 1984).

Diet

Examinations of the stomach contents and a faecal pellet of *H. australiacus* have revealed that a broad range of arthropod groups are included in the diet. Webb (1983, 1987) found ants, followed by beetles, to be most numerous in the stomachs. The other groups recorded include woodlice, cockroaches, collembolans, grasshoppers, moths, and a significant proportion of noxious or potentially venemous prey in the way of scorpions, spiders, centipedes and millipedes (Littlejohn and Martin 1967; Rose 1974; Webb 1983, 1987). Prey size ranges greatly, from 5 mm to 65 mm in length. However, most prey items are about 10 mm long (Webb 1983, 1987). These results suggest that, like most Australian anurans, *H. australiacus* is probably a generalist predator, the primary stimulus for feeding being movement (Tyler 1989).

Conservation Status

The limited number of records of *H. australiacus* from eastern Victoria and southern New South Wales indicates that the species is rare in this area. Except for one record near Jervis Bay, there are no known records of this species between the Sydney and Bombala – Eden regions, indicating two potentially disjunct populations. Ahern (1982) classified the status of *H. australiacus* within Victoria as indeterminate, possibly threatened. Robertson (1987) described the abundance and distribution of this species as being rare in habitat of limited extent, and also assigned it indeterminate status. However, the broad range of forest types from which it has been recorded suggests that this species may have a wider geographic distribution, and be more abundant, than the present records suggest. Webb (1987) noted that *H. australiacus* is extremely cryptic and that most records of this species in New South Wales resulted from detection of calling males after heavy rain. All of the Victorian sightings of active individuals have been at night, and most were made immediately after heavy and prolonged rainstorms. In Western Australia species of *Heleioporus* are also nocturnal, emerging from their burrows every 2-4 nights to feed, and burrowing underground before sunrise (Lee 1967). If *H. australiacus* occupies a burrow by day and emerges only at night after rain, the chances of detecting it are small. This difficulty in detection is compounded by limitations of surveys on amphibians in eastern Victoria, and the low level of human presence in these forest areas.

It is notable, however, that during the past three spring-summer-autumn seasons, intensive flora and fauna surveys have been conducted on and adjacent to the Errinundra Plateau, and in other areas of East Gippsland (Duncan and Peel in prep.; Humphries *et al.* in prep.; Lobert *et al.* in prep.; Westaway *et al.* 1990; Westaway *et al.* in prep.; G. R. Gillespie unpublished data). Extensive pitfall trapping was carried out during these surveys totalling 5400 pitfall nights, with attention being given to potential habitat for *Heleioporus*. Small streams and other waterbodies were investigated, and tracks were scanned for individuals in transit on nights after heavy rainstorms typical of the region. Although conditions appeared to be favourable, on no occasion was this species detected during any of these surveys.

The impact of silvicultural practices on this forest-dependent species is not known. Timber harvesting by clearfelling may cause disturbance to habitats in several ways (A.B.R.G. 1985). The invertebrate litter fauna, a potential food source, is

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likely to be adversely affected by burning the litter layer (Campbell *et al.* 1984), which is a common practice to promote regeneration after timber harvesting.

Amphibian larvae of different species have varying ranges of tolerances to environmental variables such as temperature, salinity and nutrient levels (Duellman and Trueb 1986). In contrast to amphibian species which are able to opportunistically utilise standing bodies of water, in which fluctuations in temperature, nutrient and oxygen levels may be extreme, the larvae of species which rely on permanent streams for their reproduction are likely to be less tolerant of such changes because the normal stream environment is more stable. Stream-adapted larvae may also be dependent on particular flow rates. Excessive flow rates may flush larvae out of favourable habitat and diminished flow may affect movement, food availability, temperature and predator levels (Petranka 1984).

Within timber-harvesting areas, harvesting prescriptions require that linear streamside reserves of at least 20 m width are prescribed along either side of permanent streams, swampy ground and bodies of standing water, and 5 m along intermittent streams and gullies, to protect water quality (Conservation, Forests and Lands 1988). However, investigations by Pittock (1989) indicate that these prescriptions frequently are not met. Several studies indicate that timber harvesting and road construction activities may affect temperature, nutrient levels and water yields (Boughton 1970; Brown 1972; Clinnick 1985; Cornish and Binns 1987; Flinn *et al.* 1983; Langford and O'Shaughnessy 1980; Mackay and Cornish 1982; Metzeling 1977; MMBW 1980). While these studies do not apply directly to the range of soil types and vegetation within the known distribution of *H. australiacus*, it is apparent that streams are affected by timber harvesting to varying degrees. Such disturbances may potentially affect the viability of populations of amphibians such as *H. australiacus*. The Department of Conservation, Forests and Lands (1988) also prescribes linear reserves of at least 40 m width to link areas excluded from harvesting and reserves at various seral stages along mid-slopes and/or ridge-tops, in addition to any streamside reserves. However, it is not known whether amphibians are able to utilize these reserves as corridors.

Heleioporus australiacus is poorly represented within the Victorian National Parks system. There have recently been significant extensions to the National Parks system within the geographic distribution of *H. australiacus*, with the formation of the Roger River extension of the Snowy River National Park and the new Errinundra and Coopracambra National Parks (National Parks Amendment Act May 1988). However, only the record from Waratah Access Track is incorporated in the Roger River extension. All other records are within timber harvesting areas. Five of the more recent records of this species have resulted from intensive flora and fauna surveys by the Flora and Fauna Survey and Management Group, Department of Conservation and Environment, in eastern Victoria, and have consequently been included in areas reserved from timber harvesting. In general, the boundaries of these reserves are defined by ridge-lines, gullies, roads and other visible topographic features and vary between approximately 150 and 600 ha (Carr *et al.* 1984; Chesterfield *et al.* 1983, 1988; Macfarlane *et al.* 1984; Cherry *et al.* 1986; Opie *et al.* 1990). Reserves of this size are unlikely to maintain viable populations because the potentially small and genetically-isolated populations supported by them will be vulnerable to stochastic catastrophies such as fire, and the detrimental effects of inbreeding depression. Some of these areas are adjacent to National Parks or connected to them by other linear reserves. However, until more information on the distribution, population size, breeding biology and dispersal

of this species comes to light, the effectiveness of these reserves will remain indeterminate.

Heleioporus australiacus is one of several amphibian species occurring in eastern Victoria, whose ecology and status are poorly understood. Little information is available on their basic biology, or their vulnerability to existing land management practices. We cannot be confident that management prescriptions are adequate until the ecological requirements of these species are clarified.

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Germination in eight native species of herbaceous dicot and implications for their use in revegetation

S. McIntyre*

Abstract

Seeds collected from ten populations and eight species of annual and perennial dicot were examined for germinability after two storage periods (3-9 weeks and 18-24 weeks). *Poranthera microphylla, Wahlenbergia communis, W. stricta, Urtica incisa, Crassula sieberana, Senecio* sp. E (aff. *apargiifolius*), *Acaena ovina* and *Plantago debilis* were tested in constant and fluctuating temperatures and in dark and light conditions. All species had a germination rate of 40% or more in at least one of the treatments after 18-24 weeks storage. A wide range of germination responses was recorded and no single set of conditions resulted in optimal germination for all species. The ecological implications of the differing responses are discussed. Basic ecological profiles of a range of plants, together with existing general ecological principles, will provide the most useful information base from which to develop skills in revegetation with native herbaceous plants.

Introduction

Ecological studies of native, herbaceous dicots in Australia have lagged behind research concerned with trees, shrubs and grasses, despite the importance of herbaceous plants in most vegetation types. Herbaceous natives have also been neglected in revegetation exercises in Australia which, until recently, have concentrated almost entirely on the establishment of woody vegetation (e.g. Venning 1985). With increasing pressure on remaining areas of natural vegetation, there is a growing demand for knowledge and information that will enable disturbed areas to be restored to some semblance of their originally vegetated condition, including the understorey herbaceous component.

Herbaceous species can play a major role both as components of the restored vegetation and as agents in the establishment process. Annual and short-lived perennial plants are frequently colonizers of disturbed areas in natural vegetation, a feature that could be exploited in the restoration process. Seedling establishment is a critical phase in revegetation and a knowledge of germination characteristics will provide clues to successful management at this stage. Response to light and fluctuating temperatures indicate the importance of bare ground or canopy gaps in seedling emergence (Thompson and Grime 1983; McIntyre *et al.* 1989). Temperature response may suggest suitable planting seasons while the presence of seed dormancy may indicate the potential to develop seed reserves in the soil.

This study provides some initial germination of data for eight species of annual and perennial herb that have a widespread distribution in eastern Australia. Seed from ten populations was collected on the Northern Tablelands, New South Wales, and tested for dormancy and germinability under three germination conditions and after two different storage periods.

Methods

Seed collections were made between October and December 1988. Seed was collected either from remnant bushland on the University of New England campus, Armidale, New South Wales (grid reference Guyra 9237-695266) or from the Newholme Field Laboratory, 8 km north of Armidale. In order to obtain sufficient mature seed, collections from each population were made over a period of several

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Table 1. Details of seed collections made in spring-summer 1988. U.N.E. = University of New England campus, Armidale; Newholme = Newholme Field Laboratory, 8 km north of Armidale. Nomenclature follows Jacobs and Pickard (1981).

Species	Locality	Time of seed collection	Habitat	Parent material
Poranthera microphylla Brongn.	Newholme	Nov.	open forest	granite
Wahlenbergia communis Carolin	U.N.E.	Oct.-Nov.	open forest	basalt
Wahlenbergia stricta Sweet	Newholme	Oct.-Nov.	pasture	granite
Wahlenbergia stricta Sweet	Newholme	Nov.	open forest	granite
Urtica incisa Poir.	Newholme	Nov.	open forest	granite
Crassula sieberana (Schult.) Druce	Newholme	Oct.-Nov.	open forest	granite
Senecio sp. E (aff. *apargiifolius*)	Newholme	Nov.	open forest	granite
Acaena ovina A. Cunn.	U.N.E.	Nov.	open forest	basalt
Plantago debilis R.Br.	Newholme	Nov.	open forest	granite
Plantago debilis R.Br.	U.N.E.	Dec.	open forest	basalt

weeks. Collection details are presented in Table 1. Two of the species collected *Poranthera microphylla* and *Crassula sieberana* are monocarpic and the remaining plants are herbaceous perennials.

Germination experiments were conducted in December 1988 and April 1989. Because of inter- and intra-population variation in the timing of reproductive maturity, seed age varied from 3-9 weeks in the first trial and 18-24 weeks in the second. Freshly collected seed was dried and stored in an unheated laboratory (temperature range 15-25 °C) up until the first trial. Between the first and second trial, seeds were stored dry at 14 °C. All seeds were tested for germination in the following treatments:

1) Constant temperature, 23 °C in light
2) Alternating temperatures (8 hours at 23 °C, 16 hours at 10 °C), in light
3) Alternating temperatures (8 hours at 23 °C, 16 hours at 10 °C), in darkness.

The temperatures represent the average weekly maximum (23 °C) and minimum (10 °C) in Armidale during spring, summer and autumn. The storage temperature (14 °C) represents the mean temperature in Armidale. Germination trials were conducted in temperature-controlled cabinets illuminated with fluorescent tubes. Petri dishes were lined with filter paper. Four replicate dishes were used, each containing 50 seeds. Dishes were sealed after the addition of 3 ml of distilled water. Dark treatments were wrapped in aluminium foil. Germination was checked at weekly intervals in the light treatments. The dark treatments were checked at the end of the experiment, on day 21. Seeds were not tested for viability, but only healthy well-developed seeds were used in the trials. Percentage germination data were arcsin transformed. Confidence intervals (95%) were calculated for the transformed data which were then back-transformed for data presentation.

Results and discussion

Seed from all populations showed increased germination after storage with the exception of *Plantago debilis* (granite) and *Senecio* sp. which had very high germination in both fresh seed and stored seed (Table 2). All species had germination percentages of 40% or more in at least one of the treatments after 18-24 weeks storage. A wide range of germination responses was recorded and no single set of conditions resulted in optimal germination for all species.

Table 2. Percentage germination of eight herbaceous plants after 21 days. Seed was stored at 14°C and germinated in (1) light at constant temperature 23°C (= constant); (2) fluctuating temperatures (8 hrs 23°C, 16 hrs 10°C) in light (fluctuating) or (3) dark conditions (dark). Bold numbers are means, with 95% confidence limits indicated by the smaller numbers.

	Seed age					
	3-9 weeks			18-24 weeks		
Species	Constant	Fluctuating	Dark	Constant	Fluctuating	Dark
P. microphylla	20-**35**-52	17-**34**-51	7-**24**-45	59-**73**-86	32-**64**-92	3-**8**-14
W. communis	**0**	18-**39**-62	16-**30**-47	28-**55**-81	32-**57**-81	61-**77**-90
W. stricta (pasture)	15-**21**-28	12-**16**-21	.5-**0.5**-2	39-**48**-57	13-**29**-49	**0**
W. stricta (forest)	3-**7**-13	1-**15**-36	0-**5**-14	22-**40**-60	29-**40**-52	0-**15**-40
Urtica incisa	0-**4**-13	14-**23**-35	.5-**0.5**-2	1-**6**-16	45-**53**-61	2-**6**-13
Crassula sieberana	36-**50**-63	**0**	**0**	58-**77**-93	14-**38**-66	0-**2**-5
Senecio sp.1	58-**72**-84	65-**70**-75	53-**67**-80	68-**81**-93	68-**79**-88	64-**71**-79
Acaena ovina	6-**10**-15	20-**36**-55	2-**12**-24	0-**22**-61	30-**53**-76	17-**31**-46
P. debilis (granite)	85-**95**-100	91-**95**-98	4-**6**-10	92-**97**-100	92-**98**-99	3-**27**-61
P. debilis (basalt)	5-**34**-70	7-**13**-21	1-**2**-8	78-**84**-89	91-**94**-97	12-**21**-30

The most common response was for germination to be inhibited by darkness. This was apparent in stored seed of *Poranthera microphylla, Wahlenbergia stricta, Urtica incisor, Crassula sieberana* and *Plantago debilis*. Fluctuating temperatures appeared to be associated with increased germination in fresh seed of *W. communis* and *Acaena ovina* while fresh and stored seed of *U. incisor* germinated best in the presence of both light and fluctuating temperatures.

These results provide only a brief overview of germination responses and do not unravel the complex of behaviour that is associated with germination in most plant species. In addition, care must be taken when extrapolating responses of laboratory-stored seed to behavior in the field, as there may be important differences e.g. seed stored dry in the laboratory may be less dormant than seed exposed to wetting/drying conditions outside (McIntyre *et al.* 1989). Despite these difficulties it is possible to place some tentative ecological interpretations on the results.

Stored seed of two species (*Senecio* sp. and *Wahlenbergia communis*) had over 50% germination in all three treatments provided; all the other populations produced seed that remained dormant under at least one of the germination conditions provided. For the latter group, the development of reserves of dormant seed in the soil seems a greater possibility, as the results indicate that burial or other mechanisms could prevent germination in the field. The lack of dormancy in relatively fresh seed of *Senecio* sp. suggests that this species may not accumulate reserves of seed in the soil and if populations of *Senecio* were to be destroyed, recolonization would largely depend on dispersal of seed from seeding populations elsewhere. The presence of a pappus on the seeds of *Senecio* provides a mechanism whereby wind dispersal would be possible. None of the other species possessed mechanisms for wind dispersal. A second population (*Plantago debilis* – granite population) also exhibited full germination after only a few weeks storage, but germination of these seeds was inhibited by darkness. If freshly fallen seed of these plants were to be buried it is conceivable that a seed bank would develop.

Seeds produced in spring-summer could potentially be used for sowing in the following late summer-autumn period. This may also be the pattern of natural regeneration although it is not known whether field conditions impose dormancy on seeds, delaying their germination until later seasons. Regional climatic conditions and temperature tolerances of individual species would determine appropriate planting seasons. In southern Victoria, Hitchmough *et al.* (1989) achieved successful establishment in eight species of native dicot sown in mid-winter. The cold temperatures and frequent frosts of the Northern Tablelands may make winter sowing less suitable for some species in this region.

In situations where germination is inhibited by darkness, seeds sown on or near the soil surface may have better rates of seedling emergence. This conclusion is tentatively supported by the work of Hitchmough *et al.* (1989) who found emergence of the two light-responsive species (*Stylidium graminifolium* and *Wahlenbergia stricta*) to be restricted to the top few millimetres of soil. Seed size is also a factor in seedling emergence. Small-seeded plants (e.g. *Wahlenbergia* spp., *Poranthera microphylla* and *Crassula sieberana*), and seedlings arising from them, are likely to be adversely affected by seed burial. Interestingly, germination in these three species was inhibited by darkness, whilst that in the largest-seeded species (*Acaena ovina*) was not. Seedlings derived from larger seeds are less likely to be disadvantaged by burial as their larger size and greater food reserves assist penetration to the soil surface where photosynthesis can commence (Harper *et al.* 1970; Schimpf 1977).

The principles that apply to seed burial and emergence are also relevant to the question of soil coverings. Seedlings that are unable to establish from buried seed are unlikely to readily establish in existing plant swards or through dense plant litter (e.g. the native grass *Diplachne fusca*, McIntyre *et al.* 1989). Plants have a varying dependency on open space, and gaps in the canopy cover, to establish. Species that are particularly dependent on gaps for regeneration may be associated with a suite of inter-related ecological characteristics e.g. a light requirement for germination, stimulation of germination in response to temperature fluctuations, small-seededness, early reproduction and rapid growth rates (Grime 1979). Reproduction of such plants are disturbance-dependent and the term weediness is often applied to them, although the term weed is used for a much wider and more ecologically varied group of plants.

Generalizations such as these help us to make sense of a bewildering array of taxonomic and ecological diversity. They assist us in making informed guesses as to how unfamiliar plants may behave and in allowing revegetation projects to be planned in a more directed way (e.g. see Grime 1980). Obviously any attempts at generalization can result in a loss of information that may be important. For example, the concept of variation within a species may have important conservation and practical implications. This was evident in the species from which seed from two populations was collected (*Wahlenbergia stricta* and *Plantago debilis*). Both showed variations in dormancy of fresh seed. This type of ecological variation may have relevance in revegetation, while morphological variation can reflect genetic diversity of conservation significance. Because our knowledge of Australian herbaceous species is so limited, successful revegetation in the future will require the flexible application of general principles, combined with attention to detail and good experimentation.

Acknowledgements

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Record of a Southern Right Whale (*Eubalaena australis*) skeleton from Altona Bay, Victoria, Australia

Joan M. Dixon*

Introduction

In November 1989, following a call from the discoverer Mrs. D. Graham, the author examined parts of a skeleton which had been salvaged from Altona Bay approximately 3 kilometres from Point Cook, Victoria (37°52′S 144°52′E) (Fig. 1).

The material had been subjected to water action over a long period, the length of which could not be determined. It consisted of right and left auditory bullae, scapulae, part of the nasal septum, chevron bones and epiphysis of a vertebral body. It was in relatively good condition, apart from the right scapula, which was not saved. The material was taken to the Museum of Victoria for examination and identification, and an accession number of C27879 allocated. Examination of the scapula (Fig. 2) and bullae (Fig. 3) indicated that the specimen is a Southern Right Whale, *Eubalaena australis*.

The only other material of this species in the Museum of Victoria is a piece of baleen from Portland, (38°21′S, 141°36′E), (C23598), collected about 1861, and cervical vertebrae of a specimen lacking data (C23570). Portland Bay, south-western Victoria, was a centre of 'bay whaling' from about 1828 onward. The Right Whale was one of two species commonly frequenting the Bay, but its numbers declined markedly, to the verge of extinction.

In recent years Right Whales have been sighted near Warrnambool and this has become a popular feature of the area. The most recent sighting in western Victoria was in Apollo Bay in June 1990 (pers. comm. C. Murdoch). Lumsden and Schultz (1983) reported a sighting in eastern Victoria at Venus Bay (38°40′S, 145°46′E).

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Material in Australian and New Zealand museums

Few examples of the species are located in other Australian museums, despite intensive hunting of Southern Right Whales in the early to mid 19th century.

Aitken (1971) commented on the absence of any representative material of this species in the South Australian Museum during the period of over-exploitation which resulted in the subsequent rarity of the species. There was no authenticated sighting of *E. australis* there during the first half of the 20th century, but they were observed in South Australia from 1968, and in 1981, Aitken salvaged the bulla of a specimen 11.5 m long from Orwell Rocks (38°03′00″S, 140°44′00″E (pers. comm. Kemper, 1989).

The only other osteological material of this species in an Australian museum is held in the Western Australian Museum, an auditory bulla, M11374, collected from the Rocky Coast off Warton Street Reserve (32°00′25″S, 115°44′55″E) in 1974 by N. Green. This specimen is thought to have originated from "The Elizabeth" housing John Gilbert's collection in 1838.

In New Zealand, there is one skeleton in the Otago Museum, and a second in the Dominion Museum, Wellington (Gaskin, 1968). A skeleton with baleen from Akaroa Harbour is held in the Paris Museum.

Taxonomy and Morphology

The northern and southern hemisphere Right Whales have received considerable taxonomic attention. Available literature on *Balaena* from the northern hemisphere indicates that there is considerable variation in the form. Several species have been erected, but Corbet and Hill (1988) include only two species, *B. glacialis (australis)* from all temperate and subantarctic seas, and *B. mysticetus* from the Arctic Ocean.

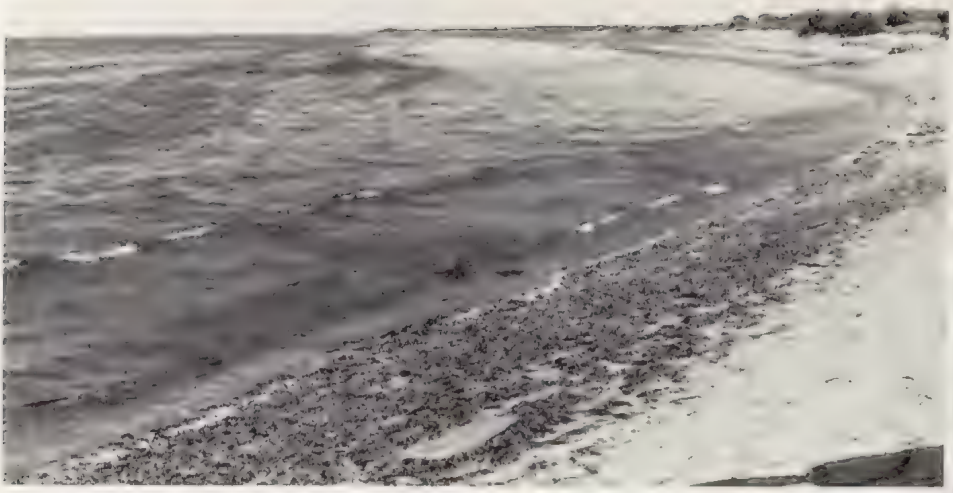

Fig. 1. Location of *Eubalaena glacialis* C27879 at Altona Bay, Victoria. Photo: J. Dixon.

Oliver (1922) comments that the degree of distinction between *B. glacialis* and *B. australis* is arguable. He had insufficient specimens available to him to make further comments. Schevill (1976) uses the name *Eubalaena australis*, which I have also used here.

Studies on the morphology of Right Whales have been undertaken by Allen (1908), Andrews (1908), True (1904), Turner (1912) and Omura *et al.* (1969). They have been involved with northern hemisphere animals, and little attention has been given to the osteology and general biology of southern hemisphere specimens.

The Altona Bay specimen

The effect of continued exposure or immersion of the Altona specimen undoubtedly weathered it considerably. The loss of ephiphyses from the vertebrae may reflect this, or it may indicate that the animal was immature.

The scapula is the only well preserved and identifiable bone of the appendicular skeleton. Its glenoid or caudal border is reasonably evenly concave from the glenoid fossa half-way to the vertebral border, but distally it is fairly straight. The two parts of the border are separated by several projecting tubercles.

The vertebral border is evenly convex. The coracoid or cranial border is short, and distally projects beyond the border in a marked tuberosity. Bony tubercles are found below it, and on the slightly concave border running proximally towards the acromion. This is a bulbous area which is directed downward and outward. Its free border is worn and convex.

The outer surface is concave in the centre, convex towards caudal and cranial borders and towards the glenoid fossa. The body of the inner surface is rounded, the sides almost flat, and the surface above the glenoid fossa convex.

The acromion is almost square, its distal edge slightly rounded, mainly due to wear. The lateral extremities are irregular, due to the presence of downwardly pointing tubercles.

Fig. 2. Left scapula of *E. glacialis* from the outer aspect (Scale 30cm ruler). Photo: J. Dixon.

Measurements of the scapula are presented in Table 1. It has not been possible to estimate the length of the specimen using the scapula measurements of other workers, although the Amangasett whale (Andrews 1908), with a slightly larger scapula than the present specimen, has a total length of 16.4 m. Baker (1983) indicates that the maximum length of the southern species is 18 m.

Bullae

The bullae of the specimen were compared with those in the literature, with an identified example from the South Australian Museum, M14135, and with the sketch of the Western Australian Museum example, M11374. The left bulla is shown in Fig. 2. Some measurements of the available Australian material are given in Table 2.

Table 1. Measurements of left scapula C27879 (in mm)

Maximum breadth of scapula	1100
Maximum height of scapula	860
Length of suprascapula curve	1350
Length of caudal border	650
Length of cranial border	810
Width of glenoid fossa	345
Length of acromion process (from glenoid fossa extremity)	350
Greatest breadth of same (at base)	375

Whaling activities in the Altona Bay region

In the early days of settlement, whaling activities were not uncommon in Port Phillip Bay. There is a record of a specimen (species not known) harpooned off Williamstown in 1839, which was sold for £80.00, and numerous records of whale chases in the area (Evans 1969). The Williamstown whaling company was proposed in 1866 to hunt in Bass Strait, but this was not successful.

Table 2. Measurements of bullae (in mm)

Museum No.	Height	Width
C27879 (left)	126	169
C27879 (right)	128	161
M14135 (left)	136	151
M11374 (left)	130	141

Fig. 3. Left scapula of *E. glacialis* C27879 from the inner aspect. (Scale 30cm ruler). Photo: J. Dixon.

Fig. 4. Left tympanic bulla of *E. glacialis* C27879. Inner surface. Photo: J. Augier.

Undoubtedly there are skeletons of flensed whales buried in the sands of the Port Phillip shoreline. The Altona Bay record is possibly one of these, but there is no positive evidence. The specimen was obviously large as indicated by the sizes of scapula and bullae. After a water-logged past its present condition is not good, but there is no obvious indication of sub-fossil origin.

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Fig. 5. Left tympanic bulla of *E. glacialis* C27879. Outer surface. Photo: J. Augier.

Plant drought messenger proves elusive

Timothy J. Entwisle

Plant physiology is often perceived by naturalists to be a difficult and dull branch of botany. To better comprehend and appreciate the world around us, however, we need to understand how and why plants behave as they do. The response of plants to drought stress has long fascinated plant physiologists, and their struggle to unravel the conflicting evidence exemplifies the triumphs and tribulations of research in the natural sciences. Local scientists Dr Tom Neales and Ms Annette McLeod are part of a world-wide research effort devoted to finding the 'drought messenger' in plants.

Experimental science can be viewed as a succession of relatively stable dogmas, each separated by a flurry of hypothesis generation and testing. Plant physiologists working on drought stress have just lost a dogma: a theory based on simple hydraulic principles has been toppled by evidence of a chemical messenger giving advance warning of water stress. Consequently, research teams in Australia and overseas are now struggling to build a new theory to explain the way plants perceive drought.

Tom Neales and his post-graduate student Annette McLeod, of Melbourne University's botany school, are trying to identify the trigger for the so-called 'drought response' in plants. How and when do the leaves received the signal to 'batten down the hatches'? Tom Neales compares leaves to wet washing hanging on a line. To slow the inevitable drying-out process, all leaves are wrapped in a waxy layer (cuticle) punctured with small apertures (stomata). Stomata open and close in response to the plant's conflicting requirements for carbon dioxide and water retention. During drought, a plant can conserve valuable water resources by early closing of its stomata, and Neales and McLeod are interested in how and when the stomata receive the message to close. The now defunct dogma stated that stomata closed due to the direct effects of water stress in the surrounding leaf tissue.

A water-balanced leaf is like a kitchen sink with the tap left running and the plug-hole open. The inlet and outlet can be adjusted so that the water stays at a constant level. If you turn the tap off, all the water is soon lost from the system. If, however, a signal could be sent to the plug-hole warning that the water level in the sink was dropping, the outlet could be plugged in time to save some of the water. Analogously, a signal sent to the stomata from the root warning of an imminent drought would give the plant a head start in conserving water. Until recently, it had been assumed that the stomata were acting, as it were, when the water level had already reached the plug-hole.

In 1987, Neales worked with Bill Davies in Lancaster, who devised an ingenious method to test this hypothesis. They placed half the roots of a sunflower into a well watered pot, and the other half into a gradually droughted pot. Since there was no shortage of water into the leaf tissue, the stomata would only shut if a chemical drought signal was sent by the 'droughted' roots. The stomata did shut, and a whole new hypothesis began to form.

At the same time, John Passioura and Rana Munns, of the CSIRO Division of Plant Industry in Canberra, effectively 'pumped up' leaf tissue to emulate full water pressure in a droughted plant. Once again, they concluded that a drought signal was overriding the water status of the leaves. It was as though the plug-hole knew the tap had been turned off well before the sink was empty.

A typical drought scenario might involve the surface roots first registering water stress and producing a messenger compound which travels through the conductive tissue of the plant. This messenger, or hormone, could accumulate in the leaf, triggering the stomata to shut. By the time the deeper soil had dried out, the plant would have already begun to conserve water.

From the work carried out at Melbourne University by Neales and McLeod, and at other research institutes around the world, the plant hormone Abscisic Acid (ABA) has been implicated as the drought messenger. It has been known for many years that ABA causes stomata to close, and more recently, that in droughted plants stomatal closure was correlated with an increase in ABA in the leaf.

Yet, although the circumstantial evidence for ABA is strong, not all researchers are convinced. It is acknowledged that ABA accumulates in the leaf when plants are droughted, but there is some disturbing evidence to suggest that ABA is not needed for stomatal closure in drought stressed plants.

The Canberra group, including Passioura and Munns, have measured the amount of ABA in the leaves of a drought stressed plant and found it to be well below the level known to close stomata. Even more damning, they found that when plant sap taken from a droughted plant, but with all the ABA removed, was fed to a well watered plant, the stomata still closed. They concluded that a messenger exists, but that it is not ABA.

Neales and McLeod set out to identify the drought signal in sunflower. As with their counterparts throughout the world, they are intrigued by the idea of a chemically based, early warning system to drought. To trace the messenger, Neales and McLeod added a 'controlled amount of drought' using a chemical osmoticum. Instead of waiting 5 days for the pot-plants to dry out naturally, the time scale could be reduced to around 30 minutes, allowing the chemical response to be closely analysed. They also used feeding experiments, with the sunflowers placed on a drip of ABA. If ABA was the primary messenger for stomatal closure, a constant supply of ABA should lead to the closed stomata, even in well watered plants. Leaf ABA levels were measured using antibody labelling.

The results were, as often happens in science, ambiguous. The stomatal response to the osmoticum treatments was too fast to be directly attributable to ABA building up in the leaves. The initial response to the ABA feeding experiments, however, was as expected: the ABA concentrations went up, and the stomata closed. But after a day, the ABA levels in the tested leaf dropped and the stomata opened again, in spite of the constant supply of ABA to the plant. So, the experiment created more problems than it solved (as is also common in science!). For instance, where was the lost ABA going? Presumably it was being broken down somewhere in the plant.

The facts as they now stand are: 1) a drought signal is produced by the root; 2) in all plants tested, the roots produce ABA when droughted; 3) the ABA concentrations in sap rise in droughted plants; and 4) stomata close before the leaves loose their turgor. The question still remaining is whether there is enough ABA to account for the closure of stomata. The next step is to measure precisely the amount of ABA in the cells controlling stomatal aperture.

Until then, scientists are caught in an unstable but exciting transition period between dogmas. The classical view of stomata shutting down only when 'the sink is empty' is at best an oversimplification, and plant physiologists are intrigued by the prospect of a chemical response to early drought stress. They eagerly await verification of their new dogma.

Field Naturalists in Victoria's Alps

*Linden Gillbank

Hikers and skiers, botanists and historians will all readily recognize the names of several FNCV members who have explored Victoria's alps. Three well-known early members, Mueller, Howitt and Stirling, carried out most of their alpine investigations before the birth of the FNCV. In the 1850s and 1860s Victoria's first Government Botanist, Ferdinand Mueller, included the alps in most of his Victorian botanical expeditions. In the 1860s and 1870s Alfred Howitt, a police magistrate in Omeo and later Bairnsdale, explored the local landscape, especially its botany and geology. Howitt later became Victoria's Secretary for Mines and Water Supply. In the 1880s, while District Surveyor at Omeo, James Stirling further studied the flora and geology of Victoria's alps. Stirling subsequently became Victoria's Government Geologist. The names of all three eminent public servants endure in the flora and physiography of the region.

Other members of the FNCV have also been instrumental in shaping our understanding of the flora of Victoria's alps – members such as Henry Tisdall, Charles Walter, Gustav Weindorfer, Francis Barnard, Charles Sutton, Alfred Ewart, James Audas, Herbert Williamson, Percival St John, and James Willis.

The Historic Places Section of Victoria's Department of Conservation and Environment has orchestrated a project on the heritage of Victoria's alps. As the author of the biological part of that project I have been investigating the history of botanical exploration of the region. After following the botanical footsteps of Mueller, Howitt and Stirling, I turned to articles in *The Victorian Naturalist* to follow other members of the FNCV as they further elaborated our knowledge of the region's flora. For readers interested in the botanical history of Victoria's alps, this paper includes some glimpses of the mountain excursions of the above FNCV members. A modified version of this paper will accompany a description of the contributions of Mueller, Howitt and Stirling in the first part of the biological section of the project's forthcoming book on the heritage of Victoria's alps.

From its establishment in 1880 until well into the 20th century, the Field Naturalists Club of Victoria (FNCV) nurtured the cognoscenti of Victoria's indigenous flora. Via the FNCV's meetings and journal, descriptions of the flora were recorded and corrected. The flora of Victoria's high country attracted much interest. Members arranged private trips to various parts of Victoria's alps and reported back to the Club on their inevitably enjoyable and sometimes exciting adventures and experiences. These reports inspired further expeditions and prompted the FNCV to arrange Club excursions in the region – but not until long after James Stirling (1887) had expressed surprise that the rich floral treasures of Mt Hotham had not by 1887 attracted a Club excursion.

Myth as well as fact added to the FNCV's interest in the region. In December 1854 Mueller climbed and named two peaks which he considered to be the highest in Victoria – Mt Hotham and Mt Latrobe. However, much to his chagrin, his names were not used. Various people have attempted to determine which two peaks he did ascend in 1854 and why his compass bearings taken from those peaks do not tally with those of other alpine visitors (Barnard 1904; Wakefield 1950). However, the myth of Mueller's 1854 ascent of Mt Hotham persisted well into the twentieth century, and was often mentioned in reports of FNCV alpine excursions.

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Henry Tisdall

One very early member of the FNCV was Henry Thomas Tisdall. He was a scientifically untrained, but observant, sub-alpine resident who was intensely interested in the organisms inhabiting his local environment. For eighteen years from 1868 Henry Tisdall was head teacher of Walhalla's first school, Stringer's Creek State School No. 957, near the Long Tunnell battery. At the third FNCV conversazione in April 1883, Tisdall exhibited a series of water-colour drawings of the wild flowers of his district, the result of several years' work, and the following September contributed his first paper entitled "A Botanical Excursion in North Gippsland". In Herman's *Report on the Walhalla Gold-Field*, Tisdall also contributed an appendix listing the plants in the vicinity. (Paull 1963; Tisdall 1961).

On Mueller's suggestion, Tisdall turned his botanical attention to the little-studied fungi. He collected, illustrated, and discussed the local fungi, including "Native Bread" which was then called *Mylitta australis*. In the absence of a closer authority some fungi were sent to Dr M. C. Cooke of London. He also sent local mosses, lichens and fungi to Mueller. Even after his transfer from Walhalla in 1886, Tisdall continued to report to the FNCV on the natural history of the district around Walhalla. (Anon 1905; Tisdall 1884-1904).

Charles Walter

Carl (Charles) Walter was another early member of the FNCV. He had arrived from Germany in the 1850s. One of many amateur botanists encouraged by Mueller to collect plants for Melbourne's Herbarium, Walter added many new species to Victorian records (Anon 1907).

After his collecting trip to the Victorian alps in January 1899, Charles Walter was asked by the FNCV Committee to exhibit the findings of his trip. At the FNCV conversazione in May, Walter exhibited about 100 herbarium specimens. So interested were Club members in these plants, that Walter was asked to prepare some notes on his excursion "for the benefit of members who may desire to visit the district and see the great beauty and profusion of our Alpine flora". In response he prepared a paper which was presented to the Club by his friend and collecting companion Charles French junior, the Assistant Government Entomologist (Walter 1899).

With the widespread publicity to attract tourists to the region in the 1880s and 1890s, it is not surprising that by 1899 Walter had already visited Victoria's alps twice. Taking advantage of the cheap excursion fares to Myrtleford, then the end of the railway line, Walter celebrated the centenary of Australia with his first trip to Victoria's alps on Australia Day 1887. He was rewarded with his first and immensely impressive view of *grevillea victoriae* in full flower, and the subsequent purchase of his numerous botanical specimens by Baron von Mueller, who had long ago discovered and named that majestic grevillea. Walter included specimens of a tall, conspicuous but un-named shrub from beside the track up from Harrietville. Three years later, accompanied by James Stirling, the Baron saw those shrubs and named them *Helichrysum stirlingii* (Mueller 1890).

In November 1891, while in charge of the Economic Botanical Section of Melbourne's Industrial and Technological Museum, Walter again visited the area to collect for the museum.

Walter's 1899 week-long trip to Mts Hotham and Buffalo was provoked by his desire to rectify the dearth of alpine plants in his own herbarium. He spent three nights at the St Bernard Hospice, from whence he collected extensively along the track between Mt St Bernard and Mt Hotham. One morning he walked to the Twins Mountains, then down to the Woods Point Track. In the afternoon he visited Mt Smythe, then followed the Dargo River

down from its source, returning to the hospice via the Grant and Crooked River road. On his return to the Ovens Valley, Walter spent a night at Manfield's Buffalo Falls Temperance Hotel, four miles from Porepunkah along the road to the Eurobin Falls. The next day he was accompanied by one of the Manfield sons on a day's collecting on the Buffalo Mountains. Included among the numerous plants he noted were the species of *Kunzea* and *Ranunculus* which Bentham had named after Mueller. Walter had already donated a collection of his Hotham plants to the St Bernard Hospice, and so, before catching the train back to Melbourne, he left a set of pressed plants collected on Buffalo with the Manfields for the information of future visitors (Walter 1899).

As Walter's trip had shown, by the turn of the century parts of Victoria's alps could be reached reasonably conveniently. Where Mueller and Howitt had plotted and slashed their own routes, there were sometimes tracks or even roads. A railway reached the foot of the alps – Myrtleford, by the 1880s, Bright by the 1890s. In summer horse-drawn coaches conveyed tourists from Bright across the mountains through Omeo to Bairnsdale. The 1910 opening of the narrow-guage railway line from Moe to Walhalla dramatically increased the accessibility of the Baw Baw plateau to visitors. Thus in the early twentieth century Mt Buffalo, Mt Hotham and environs, and the Baw Baw plateau were the main foci for FNCV excursions. A four-day collecting trip from Bright, which included Mt Hotham and Mt Buffalo, was then possible.

Gustav Weindorfer

With a particular interest in alpine plants, Gustav Weindorfer joined the FNCV within a year of his arrival in 1900 from Austria. While working at the Austro-Hungarian Consulate in Melbourne he was an enthusiastic Club member (Sutton 1932; Bergman 1959).

Weindorfer had visited Mt Buffalo in the winter of 1902 and was keen to see more of Victoria's high country. Inspired by Charles Walter's trip, two other Club members, Francis Barnard and Dr Charles Sutton, were delighted to join Gustav Weindorfer on an alpine holiday over Christmas 1902. Their trip was a slightly streamlined version of Walter's 1899 trip. After a sixteen mile drive from Bright railway terminus to Harrietville and a twelve mile walk they reached the St Bernard Hospice.

> The last mile of the road was both steep and rough, but we thoroughly enjoyed our walk, which had taken us just six hours, the invigorating nature of the mountain air making the task an easy one. After tea, arranging the specimens in blotting paper and tracing out the unfamiliar ones by the aid of the "Key" (Mueller's *Key to the System of Victorian Plants*) occupied the greater part of the evening, . . . (Barnard and Sutton 1903).

In the belief that Mueller had been 'the first white man to tread its (Mt Hotham's) grassy top and gather specimens of its singular alpine flora' they spent the day gathering specimens along the five mile track along the main ridge across Mt Blowhard to Mt Hotham, locally known as 'Baldy', the name given it by the Cobungra stockman James Brown. There they were confronted by a large flock of sheep feeding on its grassy slopes. As a corollary to Mueller's claim that Victoria's alpine flora was in part an extension of the lowland flora, they noted that the 'different forms some plants assume in these high regions are very confusing to the collector on his first visit' (Barnard and Sutton 1903). Of the plants recorded that day, over half had been named by Mueller.

After a night at Manfield's Temperence Hotel near Porepunkah they set off up

'Staker's Track' to lunch by the gorge. In the afternoon they botanized on the Buffalo plateau. They were delighted to record for only the second time in Victoria the remarkable *Prostanthera walteri*. Mueller had named it after Charles Walter who had discovered it decades earlier on Mt Ellery, East Gippsland. That evening Weindorfer, Barnard and Sutton were back in Porepunkah in order to catch the 5 a.m. train. Back in Melbourne, they were pleased to find that part of the Buffalo plateau had recently been reserved as a National Park.

Barnard and Sutton (1903) ended their *Victorian Naturalist* report with the recommendation that an extended FNCV excursion should be arranged for the region.

A year later the FNCV' s first official excursion to Mt Buffalo was arranged. Gustav Weindorfer and George Coghill organized a Christmas Camp-out from Thursday 24 December 1903 to Monday 4 January 1904. Two dozen members participated. To the surprise of the railway staff checking the compartment reserved for field naturalists, half of the party were found to be women. In the days when women were excluded from Melbourne walking clubs they were apparently not expected to be field naturalists.

The party was met at the Porepunkah railway station by their guide, Mr James Manfield junior, and conveyed by an imposing array of traps to Mr Manfield's home 'Ernai' at the foot of the mountain. On the Buffalo plateau the next day:

> The camp was within fifty feet of the edge of the Gorge, and consisted of a slab hut, in which seven ladies slept, a canvas tent-house for eight men, a dining tent, two of Mr. Mattingley's bell tents, and two small tents – a really imposing settlement, excellent in fine weather, but somewhat leaky, excepting the bell tents, in wet weather. The beds were of wire netting and logs (Coghill *et al.* 1904).

The party included people with sufficiently diverse interests to allow the recording of various aspects of the natural history of the plateau, from beetles to birds. The flora was described by Gustav Weindorfer, with Miss Kate Cowle (the future Mrs Weindorfer) helping with the mosses, liverworts and lichens. Beetles were collected and described by George Coghill and James Kershaw from Melbourne's National Museum. Over 20 of the 91 species of beetles collected were new to the Museum collection.

Concluded Weindorfer in his contribution to the *Victorian Naturalist* report:

> May this excursion serve as an inducement for others of our members to collect and study our highly interesting alpine flora, of which each visitor to the Alps cannot fail to say that here richness of colour and beauty of form exist such as only Nature herself has the power to think out and create.

During the camp-out, Weindorfer and Sutton made a flying visit via the Kiewa Valley to Mt Bogong. The weather was not welcoming. Only a day was spent reaching the foggy summit, botanizing and returning to Duane's cattle station in the Kiewa Valley, then the nearest dwelling to Mt Bogong. They left with few specimens and no views. In 1904, accompanied by Dr Charles Sutton and Herbert Williamson, Weindorfer visited another part of Victoria's alps – the Baw Baw Ranges (Sutton 1905).

As well as providing convivial means to botanically explore Victoria's alps, the FNCV also provided a forum to discuss and develop ideas provoked by those excursions. As Mueller had done, Weindorfer (1903a) considered the relationships and origins of the flora. In so doing he was asking evolutionary and ecological questions. With his knowledge of the flora of the eastern alps of Europe, Weindorfer asked whether adaptations of that flora were also present in Australia's alpine

flora. He tried to explain the presence of characteristics such as thick or hairy leaves and low compact habit, and the absence of perfumed or red or violet flowers in terms of the conditions prevailing in the Australian alps – the length of growing season, the dearth of alpine insects, and the absence of large herbivores. Weindorfer (1904a) also attempted to explain the occurrence of Australian species or their close relatives in the alps of South America and New Zealand.

Weindorfer's enthusiasm for Victoria's alpine flora reached the wider public via articles on his trips in two Melbourne Weeklies, *The Leader* and *The Australasian*. During his few years' residence in Melbourne before leaving for Tasmania in November 1905, Weindorfer had botanically explored all the reasonably accessible parts of Victoria's alps – Mt Hotham, the Buffalo and Baw Baw plateaux, and even Mt Bogong – and had discussed, asked questions about, and widely publicized the flora of Victoria's alps.

Alfred Ewart and James Audas

In 1906 Dr Alfred James Ewart FLS became Victoria's third Government Botanist, the University of Melbourne's first Professor of botany and a member of the FNCV. That year his assistant, James Wales Audas, also joined the FNCV.

Despite the collections and observations of Mueller and subsequent collectors, Ewart soon recognised the need to elaborate the botanical records of the alps. Accompanied by Audas, Ewart set off in the winter of 1910 from the Ovens valley to follow in the footsteps of a succession of FNCV members to Mt Hotham and environs. Winter seems a strange time to survey the high mountain flora. Mobilized by a bicycle, Audas collected plant specimens over a wide area. Over 200 species of plants, both indigenous and introduced, were recorded during the trip. Over 20 had not previously been recorded for the region. As previous botanists had noted, of particular interest were alpine plants of restricted range and the dwarf or prostrate forms of lowland plants (Ewart and Audas 1910).

Following his alpine visit, Ewart consolidated the species list prepared by Audas and previous visitors – Stirling, Walter, Maiden, Barnard, Sutton and Weindorfer – as well as the records of Mueller in Bentham's *Flora Australiensis*, into a single species list for Victoria's alps. This 1910 National Herbarium list included 325 indigenous species, or nearly one-sixth of the then-known Victorian flora. Ewart (1910) considered that 'it is hardly likely that the district contains any species new to science – at least as regards flowering plants – but close investigation may show the existence of alpine varieties of lowland species not previously noted'. Mueller's imprint on the flora was still clear. Nearly 20% had been collected from the region by him, while almost as many had been named by him, not necessarily from the region.

However, there were still parts of the alps that had either never been explored botanically, or had not been so explored since Mueller's visits in the mid-1850s.

Alfred Tadgell

Alfred James Tadgell worked as accountant to the Estate of the Clarke family, which included various pastoral properties. Not surprisingly Tadgell's initial botanical interest was in pastures (Morris 1949). In the 1920s he was an enthusiastic FNCV member and an ardent botanical observer of vast areas of Victoria's alps.

Tadgell followed Ewart's advice and compared his own records with the 1910 National Herbarium list. In the early 1920s Tadgell, often accompanied by the Club's treasurer, Mr Hooke, made half a dozen collecting trips along the 40 mile horseshoe from Harrietville to Mts St Bernard, Hotham, Feathertop, and back to Harrietville, and presented his findings to the Club. Two species of *Prasophyllum*

were mentioned. Dr Rogers had named *P. suttonii* following Dr Sutton's discovery of it on Mt Buffalo. Tadgell (1922) noted a reddish flowered form of *P. suttonii* and an apparently new form of *P. frenchii* which Rogers named *P. frenchii*, var. *tadgellianum*. Tadgell's visits yielded nearly 100 native and 17 alien species that had not been included in the 1910 list. Thus, in only a few years, Tadgell surprised Ewart with a 30% extension of his species list for Victoria's alps. The grand total was now 418 indigenous species and 28 aliens.

Tadgell also explored around Mt Bogong. After two trips there in the early 1920s, he compared his botanical findings with those of earlier collectors – Stirling, Sutton and Weindorfer. This highlighted the serendipitous nature of plant collecting from the same area even at the same time of year. Of the 221 native species recorded by Tadgell (1924) for Mt Bogong, about two thirds had remained unrecorded by his botanical predecessors. Between 1920 and 1930, Tadgell made about a dozen botanical forays right across the mountains between Mt St Bernard and Mt Bogong, and added substantially to the knowledge of Victoria's alpine flora and to the Census of Victorian Plants. Tadgell Point near Mt Bogong commemorates his interest in the area.

Herbert Williamson

The school teacher Herbert Bennett Williamson had joined the FNCV in 1900. By the 1920s he had acquired an FLS (Fellow of the Linnean Society) and an enormous and expanding herbarium (Daley 1931).

Early in 1922, with Chas. Daley, Williamson explored the high country round Omeo and Benambra, including 'The Brothers' and the Cobberas. By Spring Creek, Cobungra, he sought and found the aptly named *Eucalputus neglecta* – evidently the first specimens brought to Melbourne since Howitt sent some in 1882 (Daley and Williamson 1922).

On New Year's day 1923 Williamson, accompanied by another teacher, Mr S. F. Clinton, rode from Glen Willis up onto the Bogong High Plains to share a botanical holiday. One of many plants Williamson (1923) noted was:

> The luxuriant form of *Celmisia longifolia*, var. *latifolia*, with large, daisy-like flowers and broad silky-woolly leaves.

In December 1928, following one of Senator R. D. Elliot's philanthropic grants to the FNCV, Williamson was in the Cobungra district in the company of two locals, the brothers Tom and Henry Morgan, in search of fresh specimens of an orchid which Henry had discovered a year before. Following their success Pescott and Nicholls named the Golden Caladenia *Caladenia hildae* after the senator's wife. Williamson (1929) revealed several surprises including a new species of the anchor plant, *Discaria*, and a daisy, *Brachycome alpina*, previously recorded only from Pretty Valley on the Bogong High Plains, where Williamson had discovered it in January 1923. *Discaria nitida* was not formally named until 1977.

Percival St John

Another philanthropist, Russell Grimwade, was a long-standing member of the FNCV. In the 1930s he commissioned a FNCV member to work on the flora of Mt Buffalo. Percival Reginald Harry St John, a plant taxonomist at Melbourne's Botanic Gardens, was to collect, identify, mount and label specimens of the flora of the Mt Buffalo National Park. Grimwade then donated the collection of 125 specimens to the Victorian Railways Commissioners for their Chalet. That herbarium is still available for perusal by guests at the Mt Buffalo Chalet.

FNCV Excursions

The momentum of botanical interest in Victoria's high country continued through

the twentieth century. Thanks partly to the railways, by 1919 the FNCV had held two excursions in the Baw Baws, and by 1940 four on the Buffalo plateau. By the 1950s, Lake Mountain and Mts Buller and Bogong had also been officially visited by the Club. Thanks to the FNCV and its journal *The Victorian Naturalist*, information about the flora and fauna of Victoria's high country was progressively updated. As Willis (1949) wrote long ago about the FNCV:

> This body of amateurs has always been a champion of systematic botany, and it is hard to imagine what would have become of the science in Victoria had the FNCV journal, *The Victorian Naturalist*, not been available as a medium of expression and interchange of information.

James Willis

One very active FNCV member and professional botanist who has botanized throughout Victoria's alps is the now retired Assistant Government Botanist, Dr James Hamlyn Willis. Jim Willis continued the plant exploration of Victoria's alps, begun almost a century earlier by his famous predecessor, Ferdinand Mueller.

For 34 years, from 1937 to 1972, Jim Willis worked from Melbourne's Botanic Gardens and National Herbarium. For most of his first decade as an assistant at the Herbarium there was no official field work. However, his vacations could provide field botany mixed with pleasure. During a fortnight's holiday in 1938 with his friend, Raleigh Black, Willis was introduced to the vegetation of Mts Buffalo and Hotham and the Cobungra district. This whetted his botanical appetite for the region. In 1943 he visited Lake Mountain, Mt Federation, and Mt Torbreck, and doubled P. F. Morris' (1929) Lake Mountain species tally (Willis 1948).

Inspired by an earlier trip across the little-known Barry Mountains by W. H. Nicholls, Jim Willis (1945a) was pleased to join Professor T. M. Cherry and a group of Rover Scouts on another botanical vacation – a 1944 Christmas trip across the botanically unexplored rugged terrain of the Divide between Mts St Bernard and Speculation, and then on to Mts Bernard and Speculation, and then on to Mts Cobbler, Stirling, and Buller. Evidence of cattle abounded, from the well defined cattle pads and the associated weeds to dreary burnt-out hills where gaunt stands of dead trees bore mute testimony to their sacrifice to the cattlemen's goddess of new grass growth. An undescribed variety of daisy was collected and named *Helichrysum adenophorum*, var. *waddellae*. Willis (1945b) had:

> pleasure in naming it after Miss Winifred Waddell – a keen advocate for the conservation and cultivation of our native flora, and a lover of the high mountain plants in particular. Miss Waddell was first to observe the slender, pearly-pink everlastings on Mt Speculation.

The Baw-Baw Berry, *Wittsteinia vacciniacea*, which, since Mueller's discovery of it a century earlier, was known only from the Lake Mountain-Baw Baw area, and more excitingly a tiny green lily, *Chlorophytum alpinum*, previously known only from Tasmanian mountains, were important discoveries on the Cobbler plateau (Willis 1945c). Willis' check-list of 265 native plants and 58 aliens was made available for consultation in the National Herbarium.

A year later, Jim Willis' first official field trip was to Victoria's alps. At the request of Professor John Turner, in January 1946 he joined the University of Melbourne's first summer botanical excursion to the Bogong High Plains where ecological investigations on the effects of cattle were being initiated. This led to several further summer excursions with the

University group and a continued taxonomic association with the project. The importance of field work for Herbarium taxonomists could no longer escape recognition.

Jim Willis travelled widely over Victoria's alps, collecting and naming plants, and compiling regional species lists. Following his botanical survey of the Buffalo Plateau in 1963, his check-list included 300 indigenous species and 46 introduced species in the National Park (Rowe 1970).

Perhaps Willis' most important alpine botanical offspring is the magnificent Silky Daisy, whose natural home is apparently limited to parts of the Bogong High Plains. With soft silvery-grey foliage and marguerite-like heads, it is one of the most attractive botanical features of the area where, cattle permitting, it flowers abundantly during summer along rocky stream banks. Three decades after it had been noted by Williamson (1923) as a variety of *Celmisia longifolia*, Willis (1954) officially named it *Celmisia sericophylla*. Mueller's never reaching the area, the plant's palatability to cattle, and its resemblance to sister species, allowed *Celmisia sericophylla* to escape scientific recognition for a whole century.

Collections

The biological heritage of Victoria's alps is represented not only by the species surviving in the wild, but also by their records which exist in the form of collections and publications. A substantial collection of plant specimens from Victoria's alps is housed in Melbourne's National Herbarium. It currently contains specimens collected by many FNCV members – Mueller, Stirling, Howitt (mainly eucalypts), Tisdall (mainly fungi and algae), Walter, Tadgell, Williamson, St John and Willis, with a few by Barnard, Sutton and Weindorfer. More recent contributors include Cliff Beauglehole, Neville Walsh and David Albrecht.

As is obvious from this article *The Victorian Naturalist* is a rich repository for papers on the flora of Victoria's alps. Thanks to the numerous reports of FNCV members, their articles in *The Victorian Naturalist* constitute an important part of the biological heritage of the region.

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Where?

J. A. D. Blackburn*

The collector, describing in fine detail some new specimen, may not give the same attention to the description of the place from which it was obtained. In isolation a specimen is of limited value. Immediately the question arises as to what are its associations. Essential to this is a precise locality description.

The basic requirement is that it should be adequate to enable the area to be revisited and further investigation carried out if necessary. In many cases information from another discipline should be consulted and correlated and this will be difficult unless the localities in both reports are adequately described.

Place names that are meaningful to the author of the work may be a source of difficulty for the user, particularly if he is interstate or overseas. Names are frequently changed and, in mining areas particularly, can go out of use and are left off the maps. Others are local and unofficial and have never been included.

An example of the problem is Charlotte Waters in Central Australia which held equal status with Alice Springs as the most important place in that area and figures prominently in scientific and other reports. The original Alice Springs was the old

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telegraph station and is some distance away from the present town bearing the same name. On a 1968 map Charlotte Waters at 25.55'S. 134.56'E. is marked as abandoned and it does not appear at all on the 1977 edition. However, on page 266 of "Flora of Australia" Vol. 4, "Charlotte Waters" is given as the type locality for *Scerolaena longicuspis*.

In all scientific publications, but perhaps only in the index, every place name should be identified by the latitude and longitude in the same way that the postcode is an essential part of a mailing address. The geographical coordinates are often the only common reference points in maps of different origins. These, quoted to the nearest minute of arc, (eg. Ayers Rock, 25.21'S. 131.02'E.) will place you within one kilometre of the location anywhere in the world. It then can be plotted in its correct position on whatever map is at hand. The name itself loses much of its meaning unless it can be found on a map which is readily available. More often than not with scientific locations this would not be so.

For closer work the method to be used will depend on circumstances but will probably involve a dimensioned sketch with measurements from property corners or other permanent features. If the dimensions can be plotted on a plan they should enable the place to be found.

Intertidal Echidna activity

Hugh Phillipps*

On Monday 11 June 1990 I was with other members of the Victorian Wader Study Group at Barry Beach on Corner Inlet in South Gippsland. A Short-beaked Echidna, *Tachyglossus aculeatus*, was seen on the beach below, and several metres away from, high tide level. The time was about 1300, a couple of hours before high tide. The Echidna, whose tracks could been seen meandering over the beach, appeared to be foraging. The only organic matter visible in the immediate area was in the tide-wrack, mainly decomposing sea grass.

Some, possibly misplaced, concern was felt that the rising tide might endanger the Echidna, as the nearest high ground was a narrow and exposed strip of shingle that would be almost entirely surrounded by water. The animal was therefore taken, with some difficulty, a hundred metres or so back to the low dune vegetation behind the beach. There was no indication that it was sick or injured in any way; indeed, it appeared to be fighting fit.

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It seemed unusual to see an Echidna in such a place, although tracks seen at different times and other areas of the beach indicate that it might be part of its regular foraging range. A brief search of the main reference material on Echidnas found no mention of the intertidal zone as Echidna habitat, although there is an intriguing description (Newman 1990) of an animal walking through a group of oystercatchers on an intertidal mudflat to the edge of the water.

Echidnas are believed to feed almost entirely on ants and termites, although other food items such as beetle larvae have occasionally been reported. The only plausible food on the beach would have been small anthropods in the decomposing tide-wrack. Echidnas are known, however, to utilise a wide range of habitats, and the intertidal part of a beach may only be another addition to the long list of places this versatile creature may be found.

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Mount Buffalo excursion, 4-9th January 1990

Ruth Parkin

After a train trip from Melbourne and lunch under a large Red Gum (*Eucalyptus camaldulensis*) in Merriwa Park in Wangaratta, we took a bus up to Mount Buffalo via Beechworth and Bright, watching the landscape change from plains to foothills to mountains. The Buffalo Range was first seen by Hume and Hovell in 1824, and then by Major Mitchell in 1835. Mount Buffalo became a National Park in 1898, and the road to the plateau was opened 10 years later. We stayed at the 80-year old Chalet (elevation 1337 m), which is surrounded by large Rhododendron bushes, with other garden plants edging the croquet lawns, and has at its entrance a beautiful, gnarled yet stately Mountain Gum (*E. dalrympleana*).

The next morning our group walked from the Tatra Inn area across the snow plain to Dickson's Falls, named after W. Dickson, Secretary for Mines in the early 1900's. The track wandered through a pretty alpine meadow dotted with Snow Gums (*E. pauciflora*, once called *E. niphophila*, snow-lover), and we watched a Scarlet Robin (*Petroica multicolor*) flitting from branch to branch. In between rain-showers we saw many alpine plants: Alpine Podolepis (*Podolepis robusta*), Mauve Brachycombe Daisy, *Scapigera aculata*), Yam Daisy (*Microseris scapigera*), Common Billy Buttons (*Craspedia glauca*), Hoary Sunray (*Helipterum albicane* var. *buffaloensis*), Clustered Everlastings (*Helichrysum semi-papposum*), and Candle Heath (*Richea continentis*) with its cream flowerheads and spiky leaves in the sphagnum bog.

We could hear the mournful cry of currawongs across the plain. Nearby were Purple Eyebright (*Euphrasia collina*), Guinea Flower (*Hibbertia serpyllifolia*), Alpine Celery (*Aciphylla glacialis*), Grass Trigger Plant (*Stylidium graminifolium*), Derwent Speedwell (*Veronica derwentia*), Sky Lily (*Herpolerion novae-zealandie*), and our first sightings of the beautiful, green-flowering Monkey Mintbush (*Prostanthera walteri*), which is restricted to only a few mountain areas, and the tiny blue Creeping Fan Flower (*Scaevola hookeri*).

The track crossed a stream and continued through Rosy Heath-myrtle (*Baeckea ramosissima*), Alpine Heath-myrtle (*B. gunniana*), Tall Rice-flower (*Pimelia ligustrina*) and Slender Rice-flower (*P. linifolia*) before the descent to Dickson's falls. We needed to scramble over granite boulders for a view of the falls and the valley below.

During the afternoon some members explored the track to Underground River, passing Billson's Lookout with its splendid view of the Buckland Valley. The path meanders down the hill through a fine stand of Alpine Ash (Woollybutt, *Eucalyptus delagatensis*), and we saw an assortment of flowers amongst the trees: the dainty Cinnamon Bells (*Gastrodia sesamoides*), Fringe Lily (*Thysanotus tuberosus*), Tree Lomatia (*Lomatia fraseri*), Pink Heath Bells (*Tetratheca baueri-folia*), Ovens Everlasting (*Helichrysum stirlingii*), and the minute and difficult-to-see Elbow Orchid *Arthrochilus huntianus* with its tiny elbow-shape. The track descends steeply through fern gullies down to the Underground River.

We returned to the carpark by the lookouts at dusk, and spotted Crimson Rosellas (*Platycercus elegans*), Pied Currawongs (*Strephera graculina*), Grey Currawongs (*S. versicolor*) and Little Ravens (*Corvus mellori*). Early risers the next day saw and heard the Superb Lyrebird (*Menura superba*).

Descending the horse-trail to Lake Catani many more wildflowers were obser-

ved. One of the most attractive was the Orange Mountain Shaggy Pea (*Oxylobium alpestre*), named for its hairy pod. Along the track we saw Orange Everlasting (*Helichrysum acuminatum*), Scented Sun Orchid (*Thelymitra megacalyptra*), Necklace Fern (*Asplenium flabellifolium*), Rough Coprosma (*Coprosma hirtella*), Tasmanian Blue Flax-lily (*Dianella tasmanica*), and many Pale Vanilla Lilies (*Arthropodium milleflorum*). Hickory Wattle (*Acacia obliquinerva*), with its large, curved, bluish-tinted leaves, was growing prolifically, and there were large specimens of Mountain Tea-tree (*Leptospermum grandifolium*). We also saw the purple-flowering Round-leaf Mint-bush (*Prostanthera rotundifolia*), Purple Kunzea (*Kunzea parvifolia*), Elderberry Panax (*Tieghemopanax sambucifolius*), Leafy Bossiaea (*Bossiaea foliosa*), Ivy Goodenia (*Goodenia hederacea* var. *alpestre*), and the Wax-Berry (*Gaultheria appressa*).

At a large concrete bridge we paused to admire the weeping beauty of the Buffalo Sallee (*Eucalyptus mitchelliana*), also known as Willow Gum, with its spiky fruits and shiny green leaves. This species is endemic to the plateau. The red flowers of Royal Grevillea (*Grevillea victoria:* named by Baron von Mueller in honour of Queen Victoria) were just emerging nearby, and Catkin Wattle (*Acacia dallachiana*) and Lemon-scented Bottlebrush (*Callistemon pallidus*) were also present. High on the hillside above was an attractive group of pink and white Waddell Everlastings (*Helichrysum adenophorum* var. *waddellae,* named after Winifred Waddell, founder of the Victorian Native Plants Preservation Society), and we also saw the small white flowers of the Tree Everlasting (*H. dendroideum*).

After lunch by the lake, we returned to the Chalet, noting Silver Snow-daisies (*Celmisia astelifolia*) before entering more swampy country. We observed Swamp Heath (*Epacris paludosa*), Yellow Kunzea (*Kunzea ericifolia*, once named *muelleri*), Coral Heath (*Epacris microphylla*), Alpine Baeckia (*Baeckia gunniana*), Forest Phebalium (*Phebalium squamulosum* ssp. *alpinium*), Bush-Pea (*Pultenaea tenella*), Golden Moth Orchid (*Diuris pedunculata*), the purple Mountain Milkwort (*Conosperma retusum*), and many Bird Orchids (*Chiloglottis gunnii*) with their perianth resembling the open mouth of a young bird. The track continued past the site of Grossman Sawmill (1907-1912), and growing along the track were Buttercups (*Ranunculus graniticola*), a Mountain Gentian (*Gentianella demensis*), Creamy Stackhousia (*Stackhousia monogyna*), Alpina Westringia (*Westringia senifolia*), Mountain Pepper (*Tasmannica lanceolata*) and Purple Violets (*Viola betonicifolia*). Later we saw Mountain Plum-Pine (*Podocarpus lawrencei*) and St. John's Wort (*Hypericum perforatum*).

The next day we proceeded to the Gap Lookout to view the Buckland Valley below. Around our feet the dainty, pink-flowered Alpine Boronia (*Boronia algida*) was growing prolifically. Alpine Grevillea (*Grevillea australis*), with its small cream flower, and a white variety of a trigger plant (*Stylidium* sp.) grew beside the Gorge Walk path, which led through Myrtle Tea-tree (*Leptospermum myrtifolium*) and Shrubby Platysace (*Platysace lanceolata*, with tiny white blossoms) to Pulpit Rock, facing the precipitous north wall of the Gorge. At the foot of the rock some bright Golden Everlastings (*Helichrysum bracteatum*) were blooming in a small grey crevice. Near Wilkinson's Lookout were the Cascade Everlasting (*H. thyrsoideum*), Gorse Bitter-Pea (*Daviesia ulicifolia*) and the Handsome Flat Pea (*Platylobium formosum*). As we returned to the Chalet we could see the Victorian Christmas Bush (*Prostanthera lasianthos*) among the tall eucalypts.

After lunch we walked the undulating track to the Monolith through much colourful bush, including Orange Shrubby Pea, Alpine Wattle (*Acacia alpina*), the Hop Bitter-pea (*Daviesia interfolia*),

White Alpine Mint-bush (*Prostanthera cuneata*) and a vast patch of Ivy-leaved Violets (*Viola hederacea*). There was evidence of the early saw-milling activities in the area. Close to the Monolith was a small patch of Tufted Blue Lily (*Stypandra caespitosa*) and Alpine Everlasting (*Helichrysum hookeri*).

Our last full day was overcast, but some brave souls ventured forth to ascend the Horn, returning after a deluge. Baron von Mueller and J. Dallachy (Superintendent of the Melbourne Botanic Gardens) ascended the Horn in 1853, and *Kunzea muelleri* and *Acacia dallachiana* are named after these two eminent botanists. The mist closed in, however, and we retreated to the warmth of the Chalet lounge to peruse the four large volumes of the Flora of Mt. Buffalo, selected by Government Botanist St. John and given to the Chalet by Russell Grimwade in 1938: an informative and fitting conclusion to our stay. Mt. Buffalo was called "The Garden of the Gods" by E. J. Dunn, secretary of the Mines Department who made a geological survey of the area in 1907, and this perhaps best describes the hours of pleasure one can spend botanising there.

Botanical names are taken from the Mt. Buffalo Plant List, National Parks Service (Victoria), 1982.

The marine life of Heron Reef
(Report of a talk by Julie Marshall at the August general meeting of the FNCV)

The Great Barrier Reef stretches for almost 2000 km parallel to the north east Australian coastline. Heron Island is situated in the Capricorn-Bunker Group which is at the southern end of the Great Barrier Reef about 70 km from the Queensland coastal town of Gladstone.

Heron Reef is approximately 11 km long and 4-5 km wide. Originally discovered during the surveying trip of the H.M.S. Fly in 1843, the island was first used by turtle canners. Eventually the island was taken over in 1932 by Christian Poulson who established a small resort. In 1973 the P & O Shipping Line took this over and greatly expanded it so that it now caters for over 200 guests. They have also recently dredged out a large harbour to accommodate a 'wave piercing catamaran'. Heron Island is a coral cay, and, apart from Green Island, this is the only resort situated on a cay. The University of Queensland also has a research station on the island. The marine life of the reef has been protected since the 1960s.

The beach zone

Bird life

The dominant bird life consists of terns, herons and shearwaters. The White-capped Noddy Tern (*Anous minutus*) provides guano for the Pisonia trees in which it nests, and also disperses the seeds of the tree which stick to its feathers. The nests are made from the leaves and twigs of the Pisonia trees.

Reef Herons are common. They have two colour varieties within the same species, and both white and grey phases are found at Heron Island.

The Wedge-tailed Shearwater nests on the island from November to March. From April to May the large fluffy chicks have trial flights.

Turtles

Green and Logger-Head Turtles come ashore on the rising tide at night during the summer months. They lay their eggs in a chamber (hollow dug in the sand)

above the high tide mark. They lay a clutch of 100 to 150 eggs, which are soft and rather like ping pong balls. They hatch in 50 to 80 days. The temperature of the sand controls the sex of the hatchlings. The biggest day time predator of the hatchlings are sea gulls, whilst the ghost crab and the red-eye crab lie in wait on the beach and rocks at night for emerging turtle hatchlings.

Marine life in the intertidal zone

At low tide a large amount of the reef rim and reef flat is exposed. This area can be divided into a number of zones. There is the beach rock which houses chiton populations which graze on algae at night. Then a shallow gutter off shore which always contains about 1 m depth of water. Here, underneath dead coral boulders are terebellid worms which live in a tube made of fine sediment and which have long feeding tentacles. The swimming bivalve, *Lima fragilis*, is also found. It moves by clapping the valves of its shell together and expressing the water – a form of jet propulsion.

In the inner or sandy zone are broad expanses of sand with sparse clumps of living coral. The main animals here are holothurians (commonly known as Sea Cucumbers because of their shape). These have mouths ringed by tentacles which sweep the sand into the gut, extract the food, and expel the remains through the anus. Many species when molested throw out part of their internal organs (called Cuverian tubules) through the cloaca. These tubules elongate and become very sticky. They also contain toxic substances which can poison a predator. Minute calcium carbonate spicules are embedded in their skin. Some species are still a popular food for the Chinese.

Many species of nudibranchs are found in the shallows including one of the largest – the Spanish Dancer, *Hexabranchus sanguineus*. Nudibranchs are molluscs although they all lack shells as adults. Their name means 'naked gills' and many species carry their gills clearly visible on their back (mantle). Most species of nudibranch are brightly coloured and this seems to warn other animals that they are unpalatable and they in fact have few predators. Nudibranchs are carnivorous feeding on a variety of organisms such as sponges, bryozoans, ascidians and coelenterates, especially hydroids. The Spanish Dancer is one of the few nudibranchs which can swim. It does this by unfurling and undulating its mantle. It is about 25 cm in size but most nudibranchs are much smaller, some only being a few mm.

Gastropod molluscs can be divided into three main subclasses – the pulmonates (e.g. the Common Land Snail), the opisthobranchs (which include the nudibranchs) and the prosobranchs which include most of the other shells which can be found in the reef shallows, such as the baler shell, volutes such as *Amoria maculata*, spider shells (*Lambis lambis*) and mitre shells. Large numbers of the clam *Tridacna maxima* are found in the coral clumps.

Corals include the massive coral, *Goniopera*, brain corals, soft corals such as *Sarcophyton*, and the Staghorn Coral (*Acropora*). The main predator of corals are starfish but some nudibranchs also feed on corals (e.g. *Phestilla lugubris* on Gonopera).

Starfish can regenerate an arm if it is broken off. Many extrude their stomach externally to digest their prey. They use digestive enzymes to dissolve the tissue before ingesting. Heron Reef is largely free of the Crown-of-thorns Starfish which devastate coral reefs further north.

Sea urchins are also common e.g. *Diadema* which is light sensitive. Little black fish live symbiotically with it.

In the living coral zone, coral is well developed forming an even-topped platform encrusted with pink calcareous algae. Cowries are found in this area and also the abalone *Haliotis asinina*. It has holes in the distal part of its shell through which it expels water after the oxygen has been

removed by the gills. Hermit Crabs which inhabit dead univalve shells are common. There are many beautiful shrimps.

A sacoglossan which resembeles a nudibranch, *Cyerce nigricans* lives in this area. It is herbivorous and feeds on the Turtle Grass, *Chlorodesmis*. It has numerous flattened leaf like cerata on its back. These contain branches of the gut and also glands which secrete noxious substances when the animal is attacked.

The reef crest or rim is the highest part of the intertidal zone. It is littered with large coral boulders. The underside of these shelter a large variety of life such as bryozoans, ascidians, sponges, flatworms, cowries and nudibranchs. Some nudibranchs such as *Pectinodoris trilineata* are very small and up to 50 can be found in one patch of sponge. 'Sponge crabs' carry a protective covering of sponge held in place by two of their legs. Sponges are unpalatable to most marine life and thus form a protection for the crabs.

Many Sea Hares (*Aplysia*) are found in this area. They produce a violet-purple ink-like fluid when irritated. Brittle Stars and shrimps are also common.

Marine life in the subtidal zone

The reef slope falls sharply down to about 20 m. The brilliant yellow *Tubastrea* coral can be found in caves and under overhanging ledges. Sometimes the polyps are eaten out by the mollusc, *Epitonium*. Gorgonian corals are large and branching and portray beautiful colours. Crinoids have numerous long, brightly coloured feather arms which catch plankton in the currents. They use small jointed appendages known as cirri to cling to the substrate.

Fish are various including the Blue Angel Fish, the Butterfly Fish and the Trumpet Fish. Moray Eels are large and can be aggressive and bite. It is a common sight to see larger fish with smaller 'cleaner fish' eating parasites in the larger fishes gills and mouth. Manta Rays are sometimes seen.

There are many beautiful flatworms and colourful nudibranchs, especially Chromodorids.

A feature of all these descriptions was the clear, colourful and typical environmental photography, which made the talk a valuable introduction to the life of the Heron Reef.

Noel Schleiger

Wily Violets and Underground Orchids

By Peter Bernhardt

Published by Allen and Unwin, R.R.P. $16.95, 272 pages.

A recent edition of Orbost's local newspaper, the 'Snowy River Mail' carried a letter from a reader signing herself as 'Sheila B. Wright', who posed the question 'What possible use is a potoroo, anyway?' The question was rhetorical; the writer was quite clear that potoroos are useless and that, if they were to become extinct as a result of human activities, then so be it.

The final chapter in Peter Bernhardt's book 'Wily Violets and Underground Orchids' is about a plant more 'useless' even than a potoroo. The two species of underground orchids – *Rhizanthella gardneri* in Western Australia and *Cryptanthemis slateri* in New South Wales – grow, flower and set seed entirely underground. They are very rarely seen by human eyes, and then only as a result of ploughing a paddock or accidentally kicking over a dead stump. But Bernhardt tells their remarkable story with an enthusiasm for the bizarre and the obscure details of their lives which invoked, in me at least, a sense of wonder. I have no idea what 'Sheila B. Wright' would think.

Bernhardt is currently employed at the Royal Botanic Gardens in Sydney, and is engaged in writing explanatory signs and notes for the Garden's collection of plant treasures. He was educated in the United States and in Australia, and has worked extensively in the field of pollination and reproductive biology of plants. He is also, by self-admission, the 'freak at the orchid show who pulls out a hand lens'. This is his first book.

With this background and his skills, Bernhardt is in a good position to bring, to a general audience, stories from that remarkable field, the ways and means by which plants (and animals) reproduce their kind. The field lends itself to story-telling, and any teacher will verify that telling stories is one of the best ways of getting a message across. In this case, the stories are told in a light, entertaining style which enhances their effectiveness still further.

'Wily Violets and Underground Orchids' is a collection of short chapters dealing with whatever has taken Bernhardt's fancy. There is no particular order, but the unifying theme of reproduction is covered with a variety of examples, from the flowering patterns of rainforest trees to the pollination of prairie herbs, and from bees and birds to bats and rats. Orchids and mistletoes are Bernhardt's main research interests, so these are covered in detail. In fact, six of the eighteen chapters are devoted to orchids.

As well, Bernhardt is clearly interested in literature, and this pops up in frequent literary allusions and in two chapters. One, dealing with May Gibbs' books on Gumnut Babies and Big Bad Banksia Men, is particularly entertaining for an Australian reader, as these classics of our literature are explained with a view to a predominantly American audience. The other reviews some of the more extravagant science fiction forays into the botany of man-eating (and seducing) orchids.

It is in these excursions into the bizarre and the marvellous that Bernhardt is at his strongest. At the more basic levels, covering the principals of floral morphology, pollination and adaptation, and explaining the links between these, the book is sometimes flawed by the introduction of terms and concepts which are not fully explained. But this is a minor problem, and is certainly a lesser one than an unfortunate publishing flaw, that the currently available edition is missing the colour plates referred to in the text. The black-and-white illustrations and plates are generally excellent, and I'm sure that the colour plates would have been valuable.

The importance of books like these is touched upon in the foreword by Peter Raven, Director of the Missouri Botanic Gardens, and again in the last chapter. As Bernhardt remarks in the closing paragraph:

> "The earth conceals many more tantalizing stories of botany. Will there be enough time . . . to tell them?"

I believe that few qualities are more important in our relationship with the natural world than a sense of wonder. This book is about wonderful things. I hope that even 'Shiela B. Wright' will one day simply marvel.

Kevin Thiele
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Annual report of the Botany Group of the FNCV for the year 1989

Those who are interested in the activities of the Botany Group have had another very interesting year, both at the meetings on the 'Second Tuesday' and on the excursions of the 'Fourth Saturday'. Whenever possible adjacent meetings and excursions were linked together in subject matter.

Sometimes meetings have been limited by the limitations of space in the Astronomer's Residence, and also we have missed the pleasure of being able to use the FNCV library.

Eleven meetings were held, and 9 excursions. For the meetings, the average attendance was 22, the higher attendances of the warmer months were matched by lower attendances in the winter months. For the excursions the average attendance was 17, July and August being the least popular months.

Meetings

February	Various speakers	Alpine plants and their habitats.
March	Win Bennet	From the Kimberley to the Cooper – a contrast.
April	David Cheal	An overview of the vegetation of the Mallee.
May	Graeme Stone	RCA roadside reserves.
June	Tom May	Trees, toadstools, puffballs and potoroos.
July	Various speakers	Members night.
August	George Paras	Restoration efforts of La Trobe University Wildlife Reserve.
September	Dr Sophie Ducker	Botanical exploration of the Port Phillip Bay area.
October	Hilary Weatherhead	Plant communities at different altitudes in the Swiss Alps.
November	Keith McDougal	Conservation of the Basalt Plains grasslands areas.
December	Various speakers	Members night and AGM.

Excursions

February	Lake Mountain
March	—
April	Tall forest on the Ada River (La Trobe Valley FNCV).
May	Greens Bush (Tom Sault).
June	Fungi at Kurth Kiln (Tom May).
July	Operation Revegetation Nursery (Knoxfield) and Mealy Stringybark woodland (Andrew Paget).
August	Gresswell Forest and Plenty River Gorge (George Paras and local ranger).
September	Brisbane Ranges (Norman Plover).
October	Tynong North to Gembrook – A variety of vegetation associations (Hilary Weatherhead).
November	Basalt Plains flora remnants (Keith McDougal).

New faces are always welcome. Thanks go once again to Margaret Potter, our President and to all who have contributed to the efficient running of the Botany Group. Happily 1990 will find us back in the Herbarium!

Win Bennet, Hon. Secretary

50 Years of the Australian Natural History Medallion

On 24 March 1939 J.K. Moir, president of the Bread and Cheese Club, wrote to the Secretary of the FNCV suggesting the establishment of an award – 'a variation of the Nobel awards' – as a recognition of a person's service towards protecting native flora and fauna. The idea was favourably received by the FNCV and action was promptly taken to notify organisations considered likely to be interested in such an initiative. Seventeen societies were approached, and each provided two representatives to form a committee which drew up the rules which were to govern the award. The first medallion was awarded to Alec H. Chisholm in 1940. In the fifty years since then the range of the award has widened, so that today societies and clubs thoughout Australia are invited to submit nominations for the Medallion. The first interstate award was made in 1944 with the selection of J.M. Black from South Australia. This was followed in 1946 by Queensland (Heber A. Longman), and Western Australia in 1948 (Ludwig Glauert). Reverend H.M.R. Rupp (New South Wales) received the award in 1954, and it first went to Tasmania in 1976, to Winifred M. Curtis. Twenty-seven Victorians have been awarded the Medallion, seven have gone to New South Wales, while South Australia and Western Australia have received six each, and Tasmania and Queensland two each.

All aspects of natural history have been recognised in the award, and while some Medallionists have had a broad range of interests, many have been specialists, ornithologists and botanists being the most numerous. At the other end of the scale, there has been only one who listed microscopy (together with geology and palaeontology), Frederick Chapman in 1941, and one ichthyologist, Gilbert P. Whitley, in 1967. There have been three herpetologists (Ludwig Glauert, 1948, Michael Tyler, 1950 and John Dell, 1988), while two awards have been made for conchology, the first to the South Australian, Bernard C. Cotton, in 1950, and the other to Charles J. Gabriel (1958), who joined the FNCV as a junior member in 1892, at the age of thirteen, and was very active in the Club thoughout his long association with it.

As would be expected, the early Medallionists were men, the first woman being Edith Coleman in 1949, followed by two more in the 60s, and to date eight women have now received the award.

The rules of the award drawn up by the first committee have remained substantially the same. Rule 6 read: Any person is eligible for the Award who it can be shown has increased popular or scientific knowledge of Australian Flora and Fauna, including Man, or has assisted notably in the protection or propagation of Flora and Fauna, or has discovered new species of importance, or has devoted much time to the study of the subject, or has done definite service by the publication of articles or books or by photography or by pictorial art, or by any other means. Later revisions included a time limit of a ten year period preceding the last nomination, and the currency of a nomination was extended to three years, which the General Committee in 1946 recommended as giving candidates a fairer chance. They also recommended that the Award Committee be appointed on a more permanent basis than annual election by the General Committee from its own members. Today the Award Committee consists of six members, representing different disciplines, appointed for four years, half of whom retire every two years, and the current President of the Royal Society. The main function of the General Committee, made up of representatives from participating societies, is to appoint members of the

Award Committee, and to deal with any procedural matters which arise. The secretary of this committee is appointed by the FNCV, who finance and present the award each year.

The first medallion, designed by Robin Croll, depicted an aborigine sitting on a cliff gazing out over the land, under the Southern Cross. This design was used until 1980, but after forty years' use the die was wearing out, and Council was faced with the choice of replacing it, or having a new design. The decision was made in favour of the latter. The search for a new design resulted in Council's choosing one from Matcham Skipper, in which a number of elements of botany and zoology are incorporated. The medallion is mounted on a piece of agate, thereby giving variation from year to year.

The achievements for which the Medallion is awarded have remained similar over the years, but changes of emphasis are discernible, reflecting both the progress of knowledge, and different perceptions of the role of the naturalist. The distinctions are blurred, because new species are still being discovered today, while some of the early Medallionists were more concerned with spreading general knowledge of natural history than with taxonomic description. The need for conservation, underpinned by scientific knowledge, which J.K. Moir recognised from the beginning, has become more relevant with the passing years, and is reflected in the activities and achievements of the Medallionists in the last two decades. As the Medallion goes into its second half-century, the Award Committee continue to look for people who, in their opinion, have done most to fulfill the two requirements of an award for, in the words of the original inscription on the medallion, 'special study and increasing knowledge and appreciation of Australian flora and fauna'.

Sheila Houghton

For anyone interested in more information on the Medallion a booklet entitled 'The History of the Australian Natural History Medallion' by Sheila Houghton is available, gratis. Contact the Secretary, c/- The National Herbarium (see back cover).

With Thanks

The FNCV wishes to thank the members of the Native Plants Preservation Society for their donation of $2,000 towards the maintenance of the Kinglake and Maryborough sanctuaries. These sanctuaries are vital to the conservation of flora and fauna and the generous support from the N.P.P.S. is warmly appreciated.

Ellen Margery McCulloch
Australian Natural History Medallist: 1990

The choice of Ellen M. McCulloch for this award is an acknowledgement of her dedicated and unstinting efforts in the fields of conservation and the environment, relating particularly to birds.

As an enthusiastic and tireless worker over many years in bringing the causes of birds to non-committed people, she has never compromised or deviated from this direction.

Ellen's interest in birds began in childhood as she walked to and from school in Kallista, Victoria. As an adult this interest was re-awakened when she attended Jack Hyett's general natural history lectures, run by the Council of Adult Education. Since the early 1970's she herself has been a CAE lecturer and now also leads tours.

In addition to countless articles published in ornithological magazines all over Australia she has contributed to a wide variety of journals and newspapers such as *Your Garden, The Age* (Melbourne), *Nunawading Gazette, Photography, Australian Golf, Farm Magazine, Trees and Natural Resources,* etc., etc.

She is co-author of two books: "Some Garden Birds of South-east Australia." (1970) (Collins: Sydney), and "Birds of Australian Gardens." (1980) (Rigby: Adelaide). (Reprinted 1986, 1990). Her book, "Your Garden Birds." (1987) (Hyland House: Melbourne), brings together thirty of the articles published in *Your Garden.*

Her contribution through leaflets, radio talks, workshops and seminars and as a representative on various professional organisations, has placed birds and their needs before a very wide section of the public.

She has lectured to schools, natural history societies, church groups and garden clubs.

She has organised various surveys including one on "Birds and Gardens", an endorsed Bicentennial activity, in which people from all over Australia participated. Most importantly, she always publishes the results.

She is a voluntary worker at the Museum of Victoria, and has been involved in the planning and production of videos, notably one on teaching volunteers how to handle oiled birds.

As Promotions Officer for the Bird Observers Club of Australia she is instrumental in setting up displays at shopping centres, flower shows, nurseries and libraries. She was awarded a Life Membership in 1985.

Her long-standing and ceaseless efforts for the betterment of our environment have certainly merited this recognition.

Tess Kloot

Ellen McCulloch
(Photo: Gael Trusler)

**Don't forget to resubscribe.
Subscriptions for 1991 are
due on January 1st.**

ALPINE ECOLOGY COURSES
BOGONG HIGH PLAINS
JANUARY 1991

This is an opportunity to learn about the alpine environment and associated conservation issues with people from a range of backgrounds and disciplines.

January 2-7: Introductory course for teachers, rangers, conservationists and those interested in the alpine environment. Study alpine flora, fauna, soils and their interactions in the field. At least one day scheduled for individual projects. Limited to 48 participants.

January 8-13: Advanced field studies and projects for botanists, ecologists, soil scientists and photographers - including nature photography with Colin Totterdell. Three days scheduled for specific projects. Limited to 36 participants.

The instructors have considerable experience working in the Bogong High Plains and conducting field-based courses.

Accommodation is at Howmans Gap Alpine Center.

Course Fees: $350 including accommodation, meals, instruction and course notes. A limited number of subsidised places are available for those on low incomes.

Enquiries and application forms:
Bruce West, Howmans Gap (057) 583 228
Warwick Papst (03) 479 1230 (BH)
(03) 809 2454 (AH)

Presented by the Department of Conservation and Environment

Farewell to Miss Laura White

Miss White attended the Botany Group Meeting on Thursday night and on Friday told Dr Elizabeth Turner how much she enjoyed the subject and the speaker Hilary Weatherhead. On Saturday morning the 13th October she passed away peacefully.

Age 95 years.

An obituary will be printed in a later issue of *The Victorian Naturalist.*

FNCV Diary *(cont.)*

Fauna Survey Group

General Meetings (First Tuesday)

Tuesday,, 5th February **Tuesday, 5th March**

Excursions

Saturday, 15th December
Night, Leadbeaters Possum Watch.

26th Dec. – 2nd Jan.
Xmas Camp. Nooramunga Marine Coastal Park. Sunday Island.

New Members

Metropolitan:
- Jenny Anson, Narre Warren North
- Michael Russell, Chelsea
- Helen Geyer, Langwarrin
- Tony Barton, Bundoora
- John Spencer, Brighton
- Karen Wilson, Parkville
- Louise Brown, Glen Waverley
- N. Robert Doreian, Rosanna
- Felicity Garde, Mt Waverley

Joint Metropolitan
- Beth and Eric Ibbitson, Black Rock
- Philipa Burgess and Alec Donaldson, East Kew
- Nigel and William Delaney, Sandringham
- Patrick Driver and Marita Sydes, Rosanna
- Patricia Brennan and Joseph Leahy, Oak Park

Joint Country
- Bronwen and Gordon Myall, Coffs Harbour

FNCV Membership and Subscriptions 1991

Membership fees and journal subscriptions for 1991 are due on **January 1st 1991**

Membership rates 1991

Metropolitan	$30
Joint Metropolitan	$35
Country/Interstate	$27
Joint Country/Interstate	$32
Concessional rate (Students/pensioners)	$22
Joint Concessional	$27
Junior (under 18; no *Victorian Naturalist)*	$5

Subscription rates 1991

Club subscription	$30
Within Australia	$40
Overseas	AUD $50

Field Naturalists Club of Victoria

In which is incorporated the Microscopical Society of Victoria

Established 1880

Registered Office: FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron

His Excellency, The Rev Dr John Davis McCaughey, The Governor of Victoria.

Key Office-Bearers 1989-1990

President: Dr. ARTHUR FARNWORTH, 47 The Boulevarde,Doncaster 3108 (848 2229)

Hon. Secretary: Mr. JULIAN GRUSOVIN, 1 Wartiner Court, East Oakleigh, 3166. (543 8627 A.H.)

Hon. Treasurer: Mr. BRUCE ABBOTT, 4/597 Orrong Road, Armadale, 3143. (529 4301 A.H.)

Subscription Secretary: Ms DIANNE CHAMBERS, FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

Editors: ROBYN WATSON and TIM OFFOR, FNCV, P.O. Box 4306, The University of Melbourne, Parkville, 3052. (419 3532).

Librarian: Mrs. SHEILA HOUGHTON, FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141

Excursion Secretary: DOROTHY MAHLER (850 9379 A.H.).

Conservation Co-ordinator: Mr. WIL ASHBURNER, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

Sales Officer (Victorian Naturalist only): Mr. D. F. McINNES, 129 Waverley Road, East Malvern, 3145 (541 2427)

Publicity Officer: Miss MARGARET POTTER, 1/249 Highfield Road, Burwood, 3125. (889 2779).

Book Sales Officer: Mr. ALAN PARKIN, FNCV c/- National Herbarium, Birdwood Avenue, South Yarra, 3141 (850 2617 A.H.)

Group Secretaries

Botany: Miss MARGARET POTTER, 1/249 Highfield Road, Burwood, 3125 (889 2779).

Geology: Miss HELEN BARTOSZEWICZ, 16 Euroa Avenue, Nth. Sunshine, 3020 (311 5106 A.H.)

Fauna Survey: Mr. ALEX KUTT (347 0012 A.H.)

Microscopical: Mrs. ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Membership rates 1991

Metropolitan	
Joint Metropolitan	$30
Country/Interstate members	$35
Joint Country/Interstate	$27
Concessional rate (Students/pensioners)	$32
Joint Concessional	$22
Junior (under 18; *no Victorian Naturalist*)	$27
	$5

Subscription rates 1991

Club subscription	
Within Australia	$30
Overseas	$40
	AUD $50

JENKIN BUXTON PRINTERS PTY. LTD. 1-13 ABBOTSFORD ST. WEST MELBOURNE 328 4774

CLUB IMPROVEMENT ACCOUNT		
Balance of Account at 31 December 1988	14,909	13,888
Book sales account profit	758	1,021
Balance of Account at 31 December 1989	15,667	14,909
EXCURSION FUND		
Balance of Fund at 31 December 1988	28,919	25,442
Interest on investments and bank account	3,881	3,389
Surplus on tours	2,646	88
Sundry	530	—
Less: Transfer to Kinglake Project	(2,345)	—
Transfer to Library Fund	(150)	—
Balance of Fund at 31 December 1989	33,481	28,919

FIELD NATURALISTS CLUB OF VICTORIA
BALANCE SHEET AS AT 31 DECEMBER 1989

	1989 $	1988 $
ASSETS		
Current Assets		
Cash at Bank	8,245	13,779
Cash at Bank – Bicentennial Grant	19,043	10,197
Australian Savings Bonds at Cost	—	10,000
Accounts Receivable	—	213
Stocks on Hand at Cost		
Badges & Sundries	85	85
Books for Sale	297	331
Victorian Naturalist Subject Index	765	790
	28,435	35,395
Fixed Assets at Cost		
Library Furniture & Equipment	9,328	9,328
Land – Cosstick Reserve, Maryborough	213	213
	9,541	9,541
Investment of Funds at Cost		
Australian Savings Bonds	—	8,300
Esanda Ltd. Debentures	8,600	8,000
ANZ Term Deposit	20,352	—
ANZ Savings Bank – Deposit	6,055	5,472
Bank of Melbourne – Deposit	4,321	2,443
	39,328	24,215
Building Fund		
Australian Savings Bonds at cost	900	3,100
Esanda Ltd. Debentures at cost	4,700	5,900
Bank of Melbourne – Deposit	2,172	2,773
ANZ Term Deposit	36,446	—
Cash at Bank	4,723	3,591
	48,941	15,364

Publications Fund		
Australian Savings Bonds at cost	9,100	45,380
Esanda Ltd. – Debentures at cost	2,500	5,000
Bank of Melbourne – Deposit	5,158	6,916
Telecom – Bonds at cost	—	1,500
ANZ Savings Bank – Deposit	11,956	10,804
ANZ Term Deposit	46,067	—
Book Stocks at cost	5,841	6,084
Cash at Bank	17,549	12,248
	98,171	87,932
Excursion Fund		
Australian Savings Bonds at cost	—	1,000
ANZ Savings Bank	11,981	10,826
ANZ Term Deposit	1,221	—
Cash at Bank	26,949	29,052
Sundry Creditors	(6,670)	(11,959)
	33,481	28,919
	257,897	201,366

AUDITOR'S REPORT TO THE MEMBERS OF FIELD NATURALISTS CLUB OF VICTORIA

We report that we have audited the accounts of the FIELD NATURALIST CLUB OF VICTORIA in accordance with Australian Auditing Standards.

In our opinion the accompanying accounts, being the Balance Sheet, Statement of Income and Expenditure, Notes to Accounts, Statement of Source and Application of Funds and Statement by Members of the Council, are properly drawn up in accordance with the provisions of the Companies (Victoria) Code 1981 and so as to give a true and fair view of:-

(i) the state of affairs of the company at 31 December, 1989 and of the results of the club for the year ended on that date; and

(ii) that other matters required by Section 269 of that Code to be dealt with in the accounts;

and are in accordance with Australian Accounting Standards and applicable approved accounting standards.

GORDON CLARK & ASSOCIATES — MELBOURNE
Certified Practising Accountants — March 1990

Sitting in the car at windy McLoughlins Beach I knew little of the past activities of the group I was to spend the week with. All I knew was that they were out to catch New Holland Mouse.

My association with the Fauna Survey Group began in early December 1989 when a friend of mine, a second year ecology student at La Trobe University, invited me to a meeting to be held that night at the Astronomer's Residence in the botanical Gardens, South Yarra.

Malcolm Turner, a prominent member of the group and a biologist with the DC&E, had told her that membership with the Fauna Survey team could help her career. I attended to give her moral support.

The air was hot and rich with pollen in the Botanical Gardens that night. As we trekked through the open parklands yuppy cyclists whizzed by in flurries of fluorescent limbs and whirling wheels.

It was only with difficulty that we eventually found the stately Victorian residence of the Astronomer – we had been searching for a white dome-shaped shed with a telescope sticking out of it.

When the Fauna Survey Group were all seated to begin the meeting I surveyed them. I suppose I was expecting to see the stereotype field nats of old; on the one hand the Crosby-Morrison, bushman-type naturalists, on the other the English country gentleman-type naturalists who long ago exchanged their shotguns for binoculars and picnic baskets.

The people before me, however, looked more like the congregation of a Catholic church. A distinguished old lady occupied the front seat. However to my ignorant eyes she seemed as though she would be more at home judging poodles at the Royal Dog Show than scratching in the bush for the scats of marsupial rodents.

Behind her was an elderly gentleman whose name I later learnt was Tom Sault, a long standing member of the group. More than any other present Tom embodied the bushman-naturalist image. However he later told me that he rarely sacrificed life's common comforts while on camp. He was known for pulling a little campervan on every trip and cooking such wonderful meals in it that it became known as "Tom's Restaurant".

There was a core of young people in the room who all looked as though they had done some time at university. They had that intangible feeling of leisure about them that three or four years of campus life installs in people.

The tall, blonde tradesman Russell Thompson was also present. Returning from the bush on one occasion I showed Russell a slender bone I thought came from a horse. Without lifting his eyes from the curling steam of the cup of tea he was drinking, Russell amiably said, "That's a swan's thigh bone".

My friend's contact, Malcolm Turner, was to provide the main attraction of the meeting – a talk and slides about his recent adventures which included a trip to Queensland. Malcolm gave a sly grin as he began his talk, as if to say, "Look how much fun I've been having". Physically he looked as though he was still in Queensland. While the rest of us had perhaps shed one or two winter jumpers Malcolm arrived wearing shorts and T-shirt.

As Malcolm showed us his slides the room took on a warm and homely feeling. I felt at ease with the group as we peered eagerly at the curios of nature that Malcolm had captured in his slides; things like turtle's eggs and the great boomerang tails of Southern Right Whales which he had photographed in the cold sea near Warrnambool.

Looking around at the naturalists present, their faces illuminated by the slides of northern Queensland, I reflected that each face was a slide itself, showing a keen interest in nature – and occasional disgust at Malcolm's habit of making weak puns.

Malcolm flicked the slide machine and a monster-faced Moray Eel swivelled into view. The eel's head was sticking out of its coral lair and was cupped in the hand

of a scuba-diver – Malcolm. As Mal explained his relationship with the eel, the scene took on the dreamy quality of a distant friendship hatched in some far-off polyp grove.

For me Malcolm exuded the love for nature that all keen naturalists share. When such people discuss the natural world it is as though they are talking of an old friend.

I first encountered this relationship between the naturalist and the subject of his work as a young boy watching Harry Butler on TV. You could say that I was brought up "In the Wild with Harry Butler" because the show gave me many of my first insights into the bush.

Harry's program left me with two strong needs; a desire to understand the natural world and an urge to preserve it. As the meeting concluded I felt that this group could become the outlet for these needs that I had been waiting for.

Despite this it was still with some reluctance that I put my name down for the forthcoming trip to St Margaret's Island. Long camps with family and friends had taught me to be suspicious of spending time at such close quarters with people I had newly met. However the possibility of finding the New Holland Mouse lured me and I ended up signing to go.

Nothing went well on the first day of the St Margaret Island camp. We carted our luggage the one hundred metres or so to the end of the McLoughlin's Beach pier under guerilla attack from squall-force gusts of wind.

It was then a matter of waiting for the DC&E launch that had been arranged to drop us at the island. However the launch only stayed long enough for its captain to tell us that one of its motors was out and that they were not going to risk a trip to the island in those conditions.

We reloaded our cars and drove to the McLoughlin's Beach jetty. This long footbridge crosses a muddy backwater separating part of the Ninety Mile Beach known as Reeves Beach from the mainland.

We camped the next few nights in a dell behind Reeves Beach, an area, according to Malcolm, where New Holland Mouse had been found. When the winds eventually died away we emerged from the heath, spread our gear across the middle of the jetty and again waited for the fateful DC&E launch. Standing and sprawling forlornly about the breezy jetty we must have appeared to the locals like a group of refugees.

However I was learning too much to worry about the occasional hardship. I had always enjoyed camping and considered myself a lover of the bush but a week with the Fauna Survey Group soon showed me how little I knew of my beloved.

The group had immense collective knowledge. There were science graduates like Eva Demetriadus, Sarah Brown, Karen Lester and Malcolm Turner on the trip. Jenny Chappill had a Ph.D in Eucalypt Taxonomy. Russell Thompson was, of course, great with bones and Wendy Clarke was partial to spiders. Whatever the field there were people in the team who knew something about it.

As one of several novices in the group I was made to feel welcome. When an animal was caught the experienced people were happy to explain the creature to us and answer our questions.

Without complaint everyone who felt the need set about the often difficult tasks before them. There were pitfall lines to be filled in and new ones to be dug. There were traps to be set, 10 to a person, and bat mist nets to be checked at regular intervals before bed. And of course there were morning and night swims to be had on the island's pristine beaches (that is, when we did get to the island).

At night Malcolm took us spotlighting into a grove thick with spiny Grass-trees and saw-leafed Banksia. We were looking for pigmy possums. However our quest for these animals ran like an episode of "Scooby Doo", the children's cartoon of the seventies. Whenever Malcolm stopped those in the darker back ranks would keep

The Victorian Naturalist

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Compiled by K.N. Bell